PATRIOTIC WAR NUMBER

Railway Age Gazette

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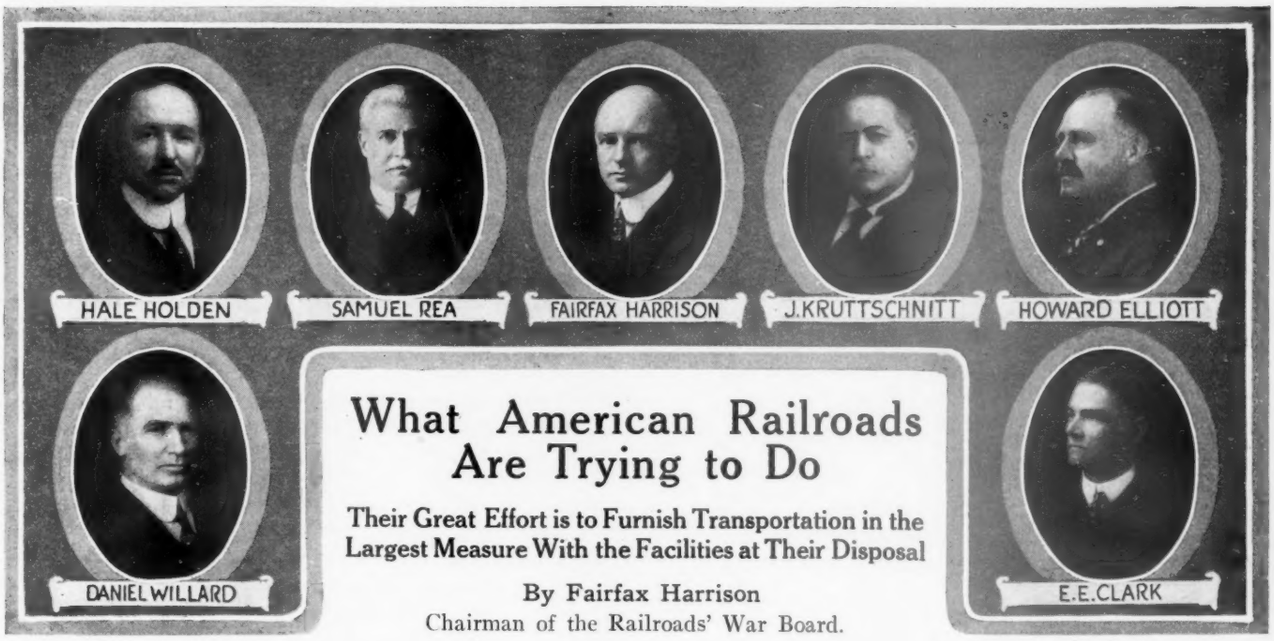
"TO the men who run the railways of the country, whether they be managers or operative employees, let me say that the railways are the arteries of the nation's life and that upon them rests the immense responsibility of seeing to it that those arteries suffer no obstruction of any kind, no inefficiency or slackened power."

Woodrow Wilson



What American Railroads Are Trying to Do

Their Great Effort is to Furnish Transportation in the Largest Measure With the Facilities at Their Disposal

By Fairfax Harrison
Chairman of the Railroads' War Board.

THE railroads are far from having broken down, as has been said of them. They are producing more transportation than ever before, but still the demand is greater than the supply. During the past eighteen months the railway traffic of the country has moved in vastly increased volume tending, speaking generally, to concentrate in certain sections of the country. This has been a direct result of the war in Europe. In consequence, those sections of the country have been constantly threatened with blockade, which has only been prevented by almost continuous embargoes.

It has been necessary to move out of the congested districts cars needed for the general business of the country in other sections. In certain of the producing sections of the country as fast as cars could be driven into them they immediately moved out again and back into the congested districts with the result that an almost continuous car shortage has existed in parts of the country and a constant accumulation of loaded cars in other parts.

The same condition exists today, intensified, however, by the fact that this country having entered the war, the necessity is to continue these shipments into the congested districts of the East.

To the complications surrounding the handling of traffic under these circumstances there must now be added the fact that vastly increased purchases of material of all sorts by the army and the navy must of necessity require that a constantly increasing proportion of the transportation business of the country must be for the account of the Government.

Organization of the Railways for War

Anticipating the probability of a heavy troop movement in the near future, in March the existing railway machinery, constructed last summer for the handling of troops and supplies in co-operation with the army, was amplified by the appointment of strong committees in each army department, and the establishment of a central office in Washington.

In the latter part of that month the Council of National Defense passed the following resolution:

"Resolved, that Commissioner Willard be requested to call upon the railroads to so organize their business as to lead to the greatest expedition in movement of freight."

In response to this, on April 11 the following resolution was passed by the chief executives of the railroads:

"Resolved, That the railroads of the United States, acting through their chief executive officers here and now assembled, and stirred by a high sense of their opportunity to be of the greatest service to their country in the present national crisis, do hereby pledge themselves, with the Government of the United States, with the governments of the several States, and one with another, that during the present war they will coordinate their operations in a continental railway system, merging during such period all their merely individual and competitive activities in the effort to produce a maximum of national transportation efficiency.

"To this end they hereby agree to create an organization which shall have general authority to formulate in detail and from time to time a policy of operation of all or any of the railways, which policy, when and as announced by such temporary organization, shall be accepted and earnestly made effective by the several managements of the individual railroad companies here represented."

To accomplish the purpose set forth in this resolution, the Special Committee on National Defense of the American Railway Association was enlarged to a total of thirty-three sectional committees consisting of members of the General Committee being established in the six army departments, all under the direction of an executive committee of five, sitting constantly in Washington, with which were associated a member of the Interstate Commerce Commission, and the chairman of the Advisory Commission to the Council of National Defense, both ex-officio.

Sub-committees were appointed as follows:

Military Equipment Standards.
Military Transportation Accounting.
Military Passenger Tariffs.
Military Freight Tariffs.
Materials and Supplies.

In addition the Commission on Car Service, which had been sitting in Washington since November, dealing with the general question of car efficiency, became a sub-committee, thus having behind it not only the authority which it already had under the terms of its previous sanction, but in addition the full authority vested by the railroads in the Executive Committee.

A building was leased in Washington, in which all the work of the several committees could be conveniently performed and the forces concentrated.

Points of contact with the army were arranged by the appointment of general agents at headquarters of the army of the several departments and at each mobilization and concentration camp; these general agents cover not only

transportation matters but also those having to do with accounting.

Increase Supply of Transportation by Increasing Efficiency

It may be assumed that during the past winter more traffic was constantly offered for transportation than could be promptly handled. The necessity for giving preference in car supply to shipments made for the Government necessarily involves a corresponding reduction in that handled for commercial interests, unless the efficiency of the transportation machinery can be increased to a still greater extent.

The physical plant cannot suddenly be enlarged. It is possible, however, to increase in a measure the supply of transportation by increased efficiency and especially by co-operation between shippers and railroads.

To accomplish this, suggestions have been made and it is necessary not only for the railroads to adopt every means at their disposal, even at increased cost, but that every shipper and receiver of freight do his part to carry out the suggestions made to them from time to time, with this end in view.

An army is to be created. From a transportation point of view this involves the erection of many cities, each having many thousand inhabitants. These cities must be constructed within a very short time. All the material for their construction must be assembled by the railroad; cars must be furnished to move it; tracks must be laid on which to dispose of it; after the cities are built, facilities must be provided and the subsistence of the army living in these cities must be assured.

An army must be sent across the water. The part of the railroads in this is to mobilize their equipment to provide for the prompt movement of vast bodies of men at such times and to such points as the Government may designate. There can be no failure nor delay. It will involve treating coaches, cars and locomotives as though there were no individual ownership in them, and will necessitate use and co-ordination of terminals already vastly over taxed.

To equip this army, vast quantities of material must be moved from all conceivable points to be concentrated where it is to be used.

Public Must Continue to Be Served

During the time that these things are being done, the food supply of our people must be made available for them by transportation. This involves not only the movement of meats, grain, vegetables, fruits, canned goods, etc., but also the movement of all the commodities which go into their production or into their preparation for the market, that is, agricultural implements, harvesting machinery, cans and the material of which cans are made, boxes and barrels, and the wood or other material of which they are constructed, involving a vast transportation necessity. Their other necessities must be provided for—houses to house them, clothing and shoes for their use, and above all coal to keep them warm and to continue without stoppage the work of the manufacturing plants on which the production of these things depends.

Transportation of the shells, rifles and other munitions with which the war is to be fought must be provided for, and in every case the movement of the material of which they are made must be given preference over less important materials.

All these things are to be brought into relation with each other. Those who are charged with the responsibility of seeing that food is created and distributed, that coal is provided, that troops are moved, that munitions are available, all these, beyond their purpose to serve the Government, meet but upon one common ground, namely, in requiring that transportation be furnished.

Railways Trying to "Furnish Largest Measure of Transportation"

To furnish this transportation then in the largest measure is what the railways are trying to do. The transportation machine, in spite of the vicissitudes of past years, is an effective vehicle for doing the business of the country and for performing additional duties which the present situation has put upon it. It cannot be suddenly amplified. That takes time, even with the Government behind it. It may be that some transportation must wait for happier times; it may be that many of those who are seeking to continue their commercial mode of living as though a state of war did not exist will have to change these methods. The common good requires that the necessary things be done first if a choice must be made.

We are at war—in a great and terrible war, fraught with limitless possibilities of danger. The measure of this has not developed. The mobilization of the effort and sacrifice we must make has not come home to many of us.

To carry this war through to a successful issue will require the utilization of every atom of our transportation system at its highest efficiency.

We have confidently appealed to every man and woman, great or small, having any part in this transportation system for the steadfast co-operation which alone can bring success.

Editorials—Patriotic War Number

WHAT THE RAILWAYS ARE DOING FOR AMERICA

GEN. JOFFRE is called the "hero of the Marne." He commanded the army which achieved the great victory that turned the German hosts back from Paris, and which may prove to have been the most important action in the world war. But Joffre says that that battle was won by the railways of France. He declares that had not the physical properties, the officials and the employees of the French railways risen level with their great task and their grand opportunity in those fateful days, all would have been lost. The loss of the battle of the Marne would have meant the fall of Paris. It might have meant the conquest of France. It might have meant to the world the triumph in this war of might instead of right, the triumph of autocracy instead of democracy.

Viewed in the light of these facts, the statement made by Gen. Joffre regarding the part played by railways in the battle of the Marne has tremendous significance. It is evident to every reflecting mind that modern war could not be conducted without railroad transportation. It is not so evident to all that the results of war may be determined largely by the character of the railroad service rendered to the different combatants. In modern war, not merely the entire military strength, but the entire economic strength of the various peoples involved, is engaged; and without good and adequate transportation they cannot bring to bear their entire military strength, and much less can they bring to bear their entire economic strength.

The United States has entered this war with good reasons and a high purpose. It has entered it to win, and to win as quickly and decisively as possible. In every step the nation takes in the prosecution of this object it will be dependent on railroad transportation. It cannot move a soldier, send a pound of food to its allies or its own forces, build a ship, make a rifle or a shell, without using railroads.

This puts an enormous burden and a tremendous responsibility upon our railway managers and railway employees. The managers appreciate this fully, and are acting accordingly. The employees soon will appreciate it fully; and when they do they also will act accordingly.

The railways have been less considerately treated by the government during the last ten years than any other industry. They were, nevertheless, the first industry to tender to the government its united and patriotic service. In less than a week after war was declared the chief executives of the railways met, subordinated their individual ambitions and the competitive rivalries of their individual lines to the welfare of the nation and created a War Board to weld all the railways into a single unified national transportation system. Their War Board has been sitting constantly since; it has been doing constructive work; and it has been receiving the loyal support of the railway heads of the country.

Not only were the railways of the United States the first industry to organize for service at home—they were the first to organize for service abroad. Already they have a commission of their experts in Russia investigating the needs of the Russian railways and another commission of their experts in France investigating transportation needs in that country. One of these commissions started westward; the other started eastward; and going eastward and westward they together have almost encircled the globe. Already our railways, under the leadership of Samuel M. Felton, president of the Chicago Great Western, also have raised nine regiments composed of their officers and employees, to go to France to do vitally needed reconstruction and operating work on the railways in that country.

No other industry in America has made such a record of patriotic sacrifice, preparedness and action as the railroad industry. But its work has only begun, and there are several vitally important points which should be powerfully emphasized for the information and stimulation of all in any way directly concerned with transportation.

1. The railways for months and years to come must handle the largest amount of traffic that is humanly possible with the facilities and labor which are available and can be provided. This necessity is forced upon them by the enormous increases of traffic which have occurred during the last two years—increases entirely unprecedented—and by the further enormous increases which will occur during and as a result of the war. The railways have not "broken down," as some say. The proof is that they are moving much more traffic now than they ever did before. But they are staggering; and the reason why they are staggering is that regulation had weakened them before the war, and that when they were the weakest these enormous increases in traffic began to be thrown upon their backs. They have not broken down; but it is a wonder they haven't, and they assuredly will unless certain things are done to increase and maintain their strength. Some of the things needed to increase and maintain their strength have been done; others are in course of being done; others remain undone.

2. It was necessary that all the purely competitive rivalries which tended to waste their strength should be stopped. A long advance has been made in this direction, but it has not been finished. For example, it is vitally essential that as soon as practicable attention be given to the unification and increase of the efficiency of the great terminals.

3. No effort should be spared to maintain equipment, roadway and structures in the very highest operating condition. This will be a very difficult task at the best; it will grow steadily more difficult; and for that reason it should be taken in hand with the utmost vigor at once. If equipment and tracks are allowed to deteriorate, that alone will be sufficient largely to defeat all efforts to increase our transportation capacity.

4. The railway managements must have the support of the regulating authorities, who entirely control their earnings and largely control their expenses. It will be far better to let the railways earn too much in the early stages of the war, even though this makes desirable offsetting reductions in their earnings later on, than to restrict earnings unduly at the start; for *now* is the time to put the properties in the best possible condition; it will grow more and more difficult to do it as time passes.

5. The railway managements must have the unstinted loyalty and support of the employees. Unless every employee does the most and best work he can, all efforts to make the railways able to carry their tremendous burden may fail.

6. The railways must be given the utmost confidence and co-operation of the traveling and shipping public. It is highly questionable if they will be able to handle all the available commercial traffic of the country, no matter how efficiently they are operated. If travelers do not consent to needed curtailments of passenger service, if shippers do not load freight cars as heavily as practicable, if shippers and consignees do not load and unload as promptly as practicable, it is certain that the supply of transportation will not be sufficient to go around. Government business must be handled first; that of the general public must be

given secondary consideration; and if there is not enough service to meet the demands of the general public, probably it will be largely due to the fact that the public has failed to give the railways its support.

The railways are doing voluntarily what they are doing for the country. Unlike many other industries, they are making no large profits out of the war. Their rates are practically the same as they were before the war, their expenses vastly greater. They have received no guarantees of previous profits or of any at all.

The course railway owners and managers are taking entitles them to the respect, the admiration, the gratitude and the co-operation of every public official concerned with regulation and, indeed, of every American citizen.

SHALL THE GOVERNMENT PROVIDE FREIGHT CARS?

SEVERAL plans involving government ownership of freight cars have been put forward to remedy the "car shortage." The most radical of these is the proposal of a Philadelphia newspaper writer that the government shall purchase all the freight cars now on the railways, furnish the additional supply needed, and itself take direct charge of the distribution of cars. A Memphis organization has suggested that the government buy 200,000 new cars and put them in service. Finally, formal consideration has been given by the Railroads' War Board to a scheme for the government to build 100,000 cars.

The government itself will need, broadly, two kinds of cars. First, it will need some special classes for purely military purposes, and useful only for such purposes. There is every reason why it should provide these itself, since, presumably, they will be needed only temporarily, and investment in them could hardly be profitable to the railways, unless especially high rates were paid for moving them. Second, the government will require the service of a large number of cars of the ordinary classes, to be used in handling ordinary freight, such as lumber for the construction of buildings for troops, foodstuffs, etc. Since in its relation to the railways when they are handling traffic for it in such cars, the government will be merely a shipper—a large and preferred one, it is true—why should it provide these cars? Why should not the railways provide them, as they provide cars for other shippers?

It is answered that the railways are unable to provide the cars which both the government and other shippers need. Why? Because they have not the financial means. Why have they not? This question apparently has not been answered by government officials, but since government authorities control railway earnings, the answer must be that the railways have not sufficient financial means because regulation has prevented them from getting them.

That is, in fact, the reason why they have not enough cars satisfactorily to handle merely the commercial traffic of the country, much less this plus the large government traffic. This being the case, it would seem that the reasonable thing for the government to do to relieve the situation, would be to make it practicable, by a change in its regulatory policy, for the railways themselves to buy the cars they need, instead of having cars built at its own expense. If cars are built for the government, they will be built at the expense of the taxpayers. If the railways are enabled to buy them, they will be built indirectly at the expense of the shippers—including, of course, the government—to whom the railways render service. Why should the taxpayers rather than the shippers bear the expense? For the taxpayers to buy cars in which to handle commercial business at rates any lower than necessary to cover the cost of transportation, including the cost of the cars, would be, in effect, to pay the shippers a subsidy at the expense of the taxpayers.

Furthermore, freight cars are not the only class of railway facilities which need to be increased. The addition of a large number of freight cars, without corresponding increases in other facilities, might tend to increase the present congestion. But if the government began supplying freight cars, there might be an increase, or at least no reduction, of the tendency of regulating authorities to deny to the railways the increases in revenues which are needed to enable them adequately to maintain and increase other facilities. Then, presently, we should hear demands for the government to go still farther into the transportaiton business.

Government provision of freight cars would be the beginning of active government participation in, as distinguished from regulation of, the railroad business; and the experience of countries throughout the world has been that when governments begin to participate in the railroad business, by guaranteeing returns, providing facilities, etc., at the expense of the taxpayers, they usually go farther and farther in this direction until they become unable or unwilling to back out; and government ownership results.

If the needed cars cannot be provided otherwise, then, let the government provide them, of course. But a more intelligent and fair policy of regulation will enable the railways to provide as adequate facilities as the government could provide out of its own treasury; and if the railways provide them in the ordinary way they will, in the long run, cost less and be more efficiently operated.

SANCTIFIED MENDACITY ABOUT RAILROADS

IT was left to a newspaper which has the word "Christian" in its name to publish the most false and uncharitable editorial which has yet appeared regarding what the railways are trying to do for the country in this war. The newspaper referred to is the Christian Science Monitor.

On May 4 the Special Committee on National Defense of the American Railway Association issued a circular, entitled "Increase the Efficiency of American Railroads." It was an inspiring appeal to railway officers and employees, and to consignees and shippers to co-operate for patriotic reasons to the utmost in order to enable the railways to increase the traffic that could be handled with the inadequate facilities available. The Christian Science Monitor commented on this circular in its issue of June 5 under the caption "Wasteful Management." It asserted that the circular afforded a "remarkable refutation" of the claims of railway managers that too much government interference had rendered them unable to provide thmselves adequately with engines and cars. It added that the committee in the circular said that "by the application of ordinary business methods to the handling of rolling stock and freight traffic the equivalent of 779,000 additional freight cars may be thrown into immediat use."

The committee said nothing of the kind. The assertion that it did is the product either of culpable ignorance or of deliberate mendacity. What the committee did say was, in substance, that the supply of cars could, in effect, be increased to the extent indicated if all railway officers and employees would show *extraordinary* diligence in handling them, and if all shippers and consignees would *voluntarily* show *extraordinary* diligence in loading and unloading them. There is a difference as great as that of truth from falsehood between the "application of *ordinary* business methods" and the making of extraordinary efforts inspired by patriotic considerations.

This is not the first time the Christian Science Monitor has thus twisted and distorted the facts about the railway business. In fact, it does so habitually. The *Railway Age Gazette,* being a secular publication, makes no claim to special sanctity; but nevertheless, it ventures to suggest to the Christian Science Monitor that it either take down its pious sign or make some effort to learn the truth and tell it.

How British Railways Are Organized for War

The Way England Worked Out Its Problem; Suggestions Concerning the Operation of American Roads

By Colonel Henry W. Thornton*

General Manager of the Great Eastern Railway, Formerly General Superintendent of the Long Island.

IN considering the operation of the British railways in war time it is perhaps as well to preface any remarks with a few words as to the normal relations of the British railways with one another and with the government.

Prior to the outbreak of the war such co-ordination as existed on British railways was mainly effected by means of the Railway Clearing House, which was established primarily to deal with the arrangements and divisions in respect of through traffic between the various systems; conferences of the executive officers of the companies were also instituted to consider matters of general interest, or on which it was desirable to secure uniformity of action.

Rates and fares as between the same points by different companies' routes, classification of goods, demurrage, liability in case of accidents, and many other matters were thus dealt with, so that in these items competition was eliminated. But in other respects strong efforts, by means of canvassing, provision of fast train service, etc., were made by the various companies to secure competitive traffic to one route as against another. The growing expenditure in recent years, however, has tended to the formation of alliances between different groups for pooling competitive traffic, thus enabling economies to be effected in working, and allowing additional facilities to be offered to the public in the way of interavailability of tickets where the same place could be reached by more than one railway included in the particular group.

The railways are subject to numerous special and general acts of parliament, some of the powers of which are exercisable by the Board of Trade and the Railway Commissioners, such as the enforcement of workmen's trains and fares and of safety appliances, inspection and approval before opening new lines for traffic and of alterations to existing lines.

Some years before the outbreak of the war, the War Office had appointed an advisory committee, composed of a few of the principal railway general managers to consider schemes of troop mobilization, but it had never been very active, chiefly because the necessity did not arise. On the outbreak of the war its functions at once became extremely important, and it was expanded to include the general managers of all the important railways—twelve in number.

Colonel Henry W. Thornton

It was to this committee (known as the Railway Executive Committee) under the nominal chairmanship of the president of the Board of Trade and the acting (and active) chairmanship of the general manager of the London & South Western that the control of the whole of the railways was entrusted when in August, 1914, the Government announced its intention to take temporary possession of the railways under the powers conferred upon it by the Regulation of Forces Act of 1861. This Act authorized the Government in the event of emergency to take possession of any railway and use it for state purposes, compensation therefor being determined either by mutual agreement or by arbitration before the railway commissioners.

Government Guarantees Returns

The question of compensation has been settled by mutual agreement on the basis of the Government guaranteeing the financial status of the last full year (1913) before the war, with provision in reference to expenditure for maintenance and renewal of permanent way, rolling stock, etc., deferred owing to the war. The railways in return undertook to convey all military traffic free of charge and placed their staff and property (including a considerable fleet of steamers) almost unreservedly at the disposal of the government. This avoided what might have been long and costly arbitrations, and the necessity of keeping complicated accounts of men and material conveyed, and also considerably reduced the accounts between companies, and enabled the railway officers to devote their energies to the task of handling the enormous government and other traffic, including the heavy

*Col. Thornton is a member of the British Railway Executive Committee which corresponds in a way to our American Railway War Board. He was born at Logansport, Ind., November 6, 1871, and studied civil engineering at the University of Pennsylvania, from which he was graduated in 1894. He began railway work as draftsman in the chief engineer's office of the Pennsylvania Lines west of Pittsburgh and for 16 years remained with that system in various capacities in the engineering and operating departments. In February, 1911, he was appointed assistant general superintendent of the Long Island, and in November of that year was promoted to general superintendent. He resigned from the Long Island and was made general manager of the Great Eastern Railway of England in February, 1914. He is Honorary Lieutenant-Colonel of the Engineer and Railway Staff Corps (Territorials).

coal and traffic diverted from coasting vessels on account of the enemy's mines, submarines, etc. Another result is that traffic is carried by the most evpeditious route, irrespective of ownership and without any anxiety on the part of any company as to the financial aspect.

In eliminating the financial necessity for seeking traffic, it also enabled the railways to revise their time tables and cut out duplicate services, excursion trains, unremunerative mileage, and what may be termed profit-seeking facilities generally. Various stations and even whole sections of line have also been closed. Furthermore, restrictions were placed upon pleasure party and race meeting arrangements, affecting the public to such an extent as only to be possible when enforced upon patriotic grounds by an executive acting with all the authority of the government behind it. I might mention here that one of the most drastic measures brought into operation, with the object of reducing railway travel, has been the universal raising of all ordinary fares by 50 per cent.

Traffic Has Increased Fifty Per Cent

All these measures have been accepted by the public in a reasonable spirit. They were not arbitrarily adopted, but were a necessity in order to enable the railways to deal with the immensely increased military and freight traffic due to the war, and at the same time to meet the demands of the government for more men and material (including rolling stock and permanent way) for railways in France and other theatres of the war. Generally speaking, the volume of traffic is at least 50 per cent in excess of what it was during the busiest year the railways had experienced previous to the war, but apart from occasional congestion and delay it has been worked satisfactorily, notwithstanding the fact that about 142,000 railwaymen (23 per cent of the pre-way staff) have joined the colors either for general or railway service abroad, and that it is being conducted with fewer engines and wagons.

It would no doubt be extremely difficult to arrange compensation on the basis of a guarantee of net income as regards the railways of the United States, but it is absolutely necessary in my opinion that as regards the provision of facilities for the conveyance of military traffic they should all work on a common plan. I am, therefore, glad to note the resolution passed by the presidents of the American railways at their meeting on April 11 last.

In England the Railway Executive Committee is established in suitable offices at Westminster in order to be in close touch with the War Office and the Admiralty, as well as other government offices. In the early days of the war the committee sat almost continuously day after day, as at that time they were chiefly engaged in executing important military movements. At present they meet weekly, but the offices are always open—day and night—and are in direct communication by private telephone with the government departments and with all the principal railways. The Secretary, or a responsible assistant, is always on duty and is in a position at any time to obtain without delay the instructions of the military authorities and communicate them to the railway staff through the company's headquarters.

The unity of control thus established, without in any way interfering with the control of the staff of the respective companies by their own officers, enables the railways to be worked as one unit to the best advantage in the interests of the nation and without detriment to the individual companies. All matters of principle and arrangements with the government affecting the railways as a whole are dealt with through the Railway Executive Committee. In some of the less important matters, including troop movements, the government departments and military commands communicate direct with the railway companies concerned, but so that there shall be no overlapping or contradictory orders it is arranged that orders are to be acted upon only when received from the recognized authority responsible for any particular section of the work. Of course this does not release any railway official from accepting responsibility and acting on his own judgment in matters of urgency, though the system works so well in practice that there has been little or no necessity for this.

Sub-Committees of Executive Committee

Sub-committees of the Railway Executive Committee consider in detail special subjects and report thereon to the Executive Committee. A few specimen matters are:

Precautions to be taken in the event of hostile air raids or invasion.

Enlistment of railwaymen for general military service or for service on railways abroad.

Manufacture of war material in railway shops.

Provision of ambulance trains.

Pooling of wagons.

Congestion of traffic.

There are also standing committees of accountants, goods managers and superintendents of the line.

Several of these sub-committees are attended by representatives of the government departments, such as the War Office, Admiralty and Ministry of Munitions. The Executive Committee is also represented on several government committees set up to deal with questions arising out of the war, such as the Priority Committee, which decides the preference with which orders for certain materials, etc., shall be executed, and a committee to arrange for the distribution of coal.

The general managers of the principal railways rank as lieutenant colonels in the Royal Engineers, and other officers (mainly chief engineers and superintendents of the line) as majors or captains. No examinations are necessary for such rank, the principal object being to bring the military and railway establishments closer together.

America's Problem Similar to Britain's

The problem in the United States is somewhat similar to that in Great Britain, except that in the last named country the possibility of an attempt at invasion has to be kept in view. I have given a broad outline of the manner in which the subject has been dealt with in Great Britain, and although owing to fundamental differences it may not be possible to proceed on exactly similar lines in the United States the method adopted has been so successful as to merit careful consideration.

I have had an opportunity of reading Documents 1 and 2 of the American Railway Association Special Committee on National Defense, and the organization therein given appears to me to be well designed to meet your particular case, provided one object is always kept in view, i. e., that there shall be perfect co-ordination and harmonious working between the Q. M. G. composite department (military plus railway) and the railway companies themselves. I might remark with reference to the paragraph in No. 1 of the American Railway Association documents as to the American plan of operation being, "in distinct contrast to that adopted in England at the outset of the war," that the position of the British railways with regard to the military is practically the same as in peace time, except that the elaborate account-keeping then necessitated is not now required, as troops and munitions are carried free of charge. The railways individually and through the Railway Executive Committee co-operate fully with the military authorities, but the method of carrying out the military requirements is left to the railways. The paragraphs of the document describing the United States' plans might very well have been written as descriptive of the British methods, viz.:

In this country the plan is that the Government shall advise the railroads what service it requires, and the responsibility will be upon the

railroad managers to provide that service. When working to that end, the railroads of the country will be operated practically as one system.

This plan places responsibility upon experienced railroad officers for producing results, and the Government's only function in this connection is to determine what its requirements are.

I presume the general agents of the railroad companies at military headquarters in the United States are there merely in an advisory capacity, and as a link between the military and the railway authorities and not as subordinate to the military authorities. Otherwise, it appears to me, it would be better to have two distinct organizations (1) the Q. M. G., with the aid of his military staff to formulate his plans and to say what his requirements are, and (2) the railway companies acting in concert to carry out the details. Of course, owing to the much greater extent of ground to be covered in the United States, these two organizations would require to be divided into districts, each responsible for the working in its own section, subject to general regulations agreed upon by the main body in Washington. There is, however, nothing like experience, and it will quickly be found whether these comments made from a distance are justified or not.

Some arrangement will probably be found necessary with regard to the cost of providing additional siding, etc., accommodation to enable the military traffic to be handled satisfactorily at certain points where troops may be concentrated, especially in a case where the earnings therefrom of the company providing the accommodation would not yield an adequate return on the outlay. In England the war office bears the immediate cost of such works, leaving the question of their retention or otherwise after the war with any consequent adjustment of payments to be then settled.

SUB-COMMITTEE ON MILITARY EQUIPMENT STANDARDS

The Sub-Committee on Military Equipment Standards of the Executive Committee of the Special Committee on National Defense of the American Railway Association (Railroad War Board) consists of seven members, of whom four are representatives of the mechanical department of the railroads; two are representatives of the car builders and one represents the purchasing department of the railroads. It is the duty of this committee to handle all problems relating to cars and locomotives which are submitted to the parent committee. It will be called upon to look after such problems as adapting existing cars to meet the needs of military service as these cars are demanded by the government and to the design of new equipment for government service. The committee is performing an important function in the scheme in the handling of the railroad problem and the war.

The committee consists of J. T. Wallis, general superintendent motive power, Pennsylvania Railroad, chairman; C. E. Chambers, superintendent motive power, Central of New Jersey; L. A. Lindstrom, assistant to the president, Pressed Steel Car Company; F. W. Mahl, director of purchases, Southern Pacific Company; Peter Parke, chief engineer, Pullman Company; R. E. Smith, general superintendent motive power, Atlantic Coast Line, and C. B. Young, mechanical engineer, Chicago, Burlington & Quincy.

Committee on Military Equipment Standards

F. W. Mahl

J. T. Wallis, Chairman

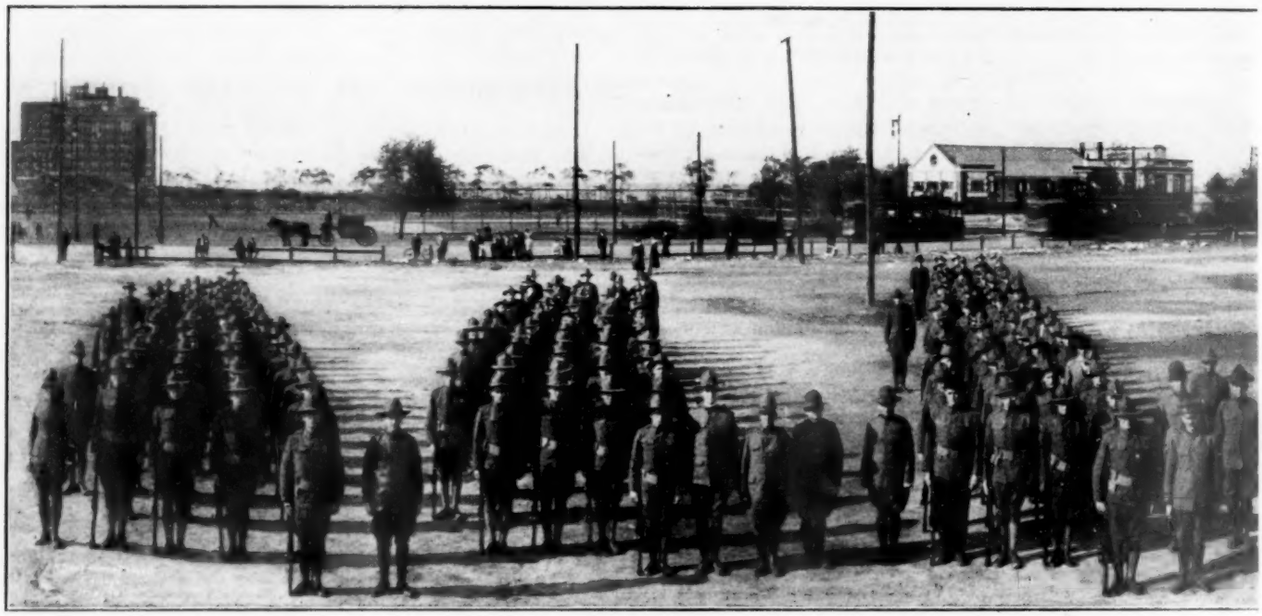
C. E. Chambers

R. E. Smith

C. B. Young

Peter Parke

C. A. Lindstrom



Third Reserve Engineer Regiment on Parade

Railway Men Organized for Foreign Service

Nine Regiments Formed and the Necessary Equipment Collected in Six Weeks for Movement to France

THE formation of nine railway regiments for service in France within the short period of six weeks is a forceful evidence of American genius for organization. The idea of recruiting the regiments directly from railroad service dates back to June, 1916, when S. M. Felton, president of the Chicago Great Western, was appointed consulting engineer and adviser to the Chief Engineer of the United States army upon the recommendation of a joint committee of five national engineering societies and of a commission appointed by the American Railway Association to confer with the Secretary of War on railway matters.

S. M. Felton

Ready for Mexico

On June 24, 1916, Mr. Felton was requested to take charge of the collection of railway men and materials for possible operations in Mexico. The plans for the movement into that country, if undertaken, contemplated the operation of the railways south from Brownsville, Tex., Laredo, Eagle Pass and El Paso. Mr. Felton's experience as president of the Mexican Central made him thoroughly familiar with Mexico and its railroads, and, therefore, specially fitted for this important assignment. Having a list of men in the United States who he knew had some knowledge of railway operations in Mexico, he immediately communicated with them and soon engaged a sufficient force to fill the more important positions. These men agreed to report at San Antonio, Tex., on the receipt of telegraphic instructions, and arrangements were made with their employers to release them temporarily in case of necessity.

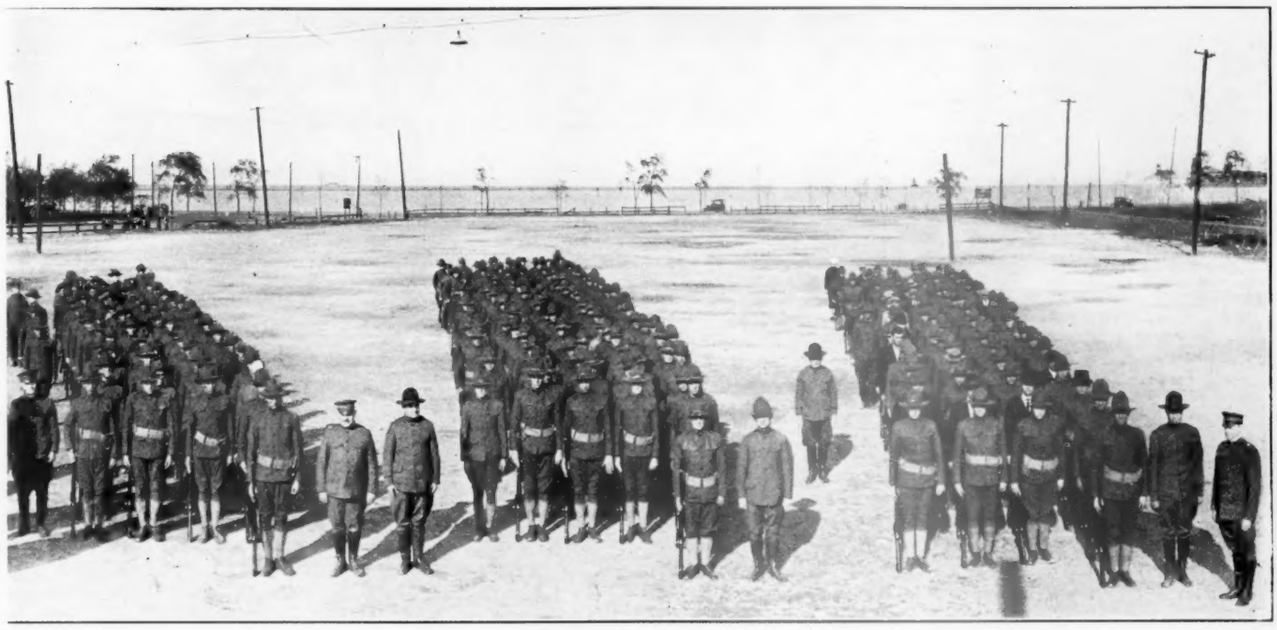
A number of railroads promised to assign a total of 100 locomotives to the government upon demand. A sufficient number of construction outfits were engaged from prominent contractors who were familiar with such work as might be required. Wrecking and construction trains, and derricks were secured in a like manner. A large amount of track materials, including 50,000 tons of relayer rails, were located and placed under option. Arrangements were made to secure 1,400,000 cross ties which were held in readiness for loading on 24 hours' notice. Through the co-operation of the Western Union Telegraph Company and the Bell Telephone Company, their entire stocks of materials were placed at the disposal of the government and plans were made for the immediate shipment of poles, wires, cross arms, instruments, and everything necessary for 1,200 miles of telephone lines, which it was intended to use not only for despatching trains but for military communications as well.

Between June 24 and 28, sufficient men and materials were located to make possible the first move across the border, and within the following week preparations had progressed far enough to insure the satisfactory operation of the railroads as fast as the army could advance. Every railroad appealed to stood ready to furnish all the men, materials and equipment possible, even to the extent of embarrassing its own operations. Manufacturers, in like manner, offered to supply track materials regardless of orders on hand.

The extension of options on materials, the purchase of smaller items of track supplies, which it was deemed wise to have in stock on the border, and similar matters were handled by Mr. Felton in co-operation with the chief of engineers during the balance of the year.

Progress with the Nine Regiments

The expedition with which preparations were made for



taking over the Mexican railroads on short notice, when the military situation on the border was most acute, rendered it logical to turn to the same organization for aid when our entrance into the European war made the formation of railway regiments desirable. The same despatch which characterized this work in the summer of 1916 has transformed the railway contingent from an idea into an accomplished fact in the course of a few weeks. At the time of writing the regiments at Chicago, New York, Pittsburgh, Philadelphia and Detroit have recruited their full complement of officers and men; the regiment at St. Louis has practically completed recruiting, and those at Boston, Atlanta and San Francisco are rapidly filling the vacancies among officers and in the ranks. Motor cars, push cars and large supplies needed in connection with track work have been ordered and shipped for the use of the construction regiments. Only small shop tools will be taken to France by the shop regiment, while the operating regiments will take the same pioneer engineer outfits used by the engineering units of the regular army.

Mission to France

For the purpose of learning the needs of the French railways at first hand a special board was sent abroad consisting of William Barclay Parsons, consulting engineer; W. A. Garrett, former vice-president of the Chicago Great Western; William J. Wilgus, former chief engineer of the New York Central; and Francois de St. Phalle, formerly manager of munitions of the Baldwin Locomotive Works. The board is now in France gathering information as to the railway situation there.

How the Regiments Are Organized

The railway contingent includes three operating regiments now located at Chicago, Boston and St. Louis; five construction regiments located at New York, Pittsburgh, Detroit, Atlanta and San Francisco; and a shop regiment, now quartered in Philadelphia. The operating regiments are organized along the lines of the operating department of a railroad and will be expected to operate any strictly military roads that may be required. Each of the six constituent operating companies is expected to be capable of taking over a section of railroad, approximately 100 miles in length, and to operate it in the same manner that it might handle the work of a division on an American line. The duties of the construction regiments will be to reconstruct railways which may be recaptured from the enemy, maintain existing railways or do any railway construction work required.

The colonel of each regiment and his captain adjutant are regular army engineer officers and the captain quartermaster an appointee of the colonel. The railways have provided the lieutenant-colonel, two majors, two captain adjutants and one captain engineer, all drawn from ranks calculated to fit them for the positions. In the operating regiments the captain of each company is a division superintendent or a railway officer of similiar experience, and the lieutenants have been drawn from engineers maintenance of way, assistant division superintendents, trainmasters, master mechanics and railroad men of similar rank. The non-commissioned officers have been drawn from men of the rank of track and bridge supervisors, roundhouse foremen, assistant engineers, section foremen, bridge foremen, etc. The ranks have been filled with conductors, brakemen, yard foremen, despatchers, track foremen, bridge and building foremen, car inspectors, wrecking foremen, storekeepers, traveling engineers, roundhouse foremen, locomotive engineers and firemen, switchmen, operators, yardmasters, pumpmen, linemen, stenographers, clerks, agents, etc.

The officers of the construction regiments are made up largely of chief engineers, engineers maintenance of way, roadmasters, track foremen and bridge foremen. The ranks are composed of track laborers and bridge carpenters.

The shop regiment has as its lieutenant-colonel a superintendent of motive power, master mechanics as majors, master mechanics and assistant master mechanics as captains, shop foremen as lieutenants, and gang foremen as non-commissioned offices. The privates include 450 machinists, 175 boilermakers, 175 blacksmiths, 50 pipe fitters and helpers, 50 cab builders and tender repairmen, 50 sheet iron workers, tin and coppersmiths, 25 car and locomotive painters, and 25 electricians, stationary engineers and firemen.

Chicago Regiment in Camp

The Chicago regiment, the Third Reserve Engineers, has unique quarters on the Municipal Pier at the entrance to the Chicago harbor. Regimental and company headquarters, the commissary department, the regimental hospital, the mess room, supplies and bunks for the men, as well as a large area for drilling purposes, are all under the roof of the spacious structure which is over one-half mile long.

Shortly after the regiment set up camp on the pier, the

Young Men's Christian Association, under the direction of W. N. Northcott, metropolitan railroad secretary at Chicago, established a branch there for the purpose of providing comforts, entertainment, and facilities for educational and moral improvement for the men. Among other things, the Y. M. C. A. furnishes parcel post, package express and express money order service; laundry service, bath towels and soap at cost; copies of the daily newspapers, railroad employees' magazines, and current periodicals. The Association quarters contain a library of 200 volumes loaned by citizens of Chicago for the use of the men, while a Victrola and a piano are available for those who are musically inclined. Among the entertainment features are stereopticon and moving pictures, talks by prominent men, musical programs, and special programs, or "stunt nights," given by the soldiers themselves every Saturday evening.

Those who have addressed the men under the auspices of the Y. M. C. A. include A. M. Schoyer, resident vice-president of the Pennsylvania Lines West at Chicago; Samuel O. Dunn, editor of the *Railway Age Gazette*, whose subject was "American Railway Men in France"; W. B. Moore, of Moore-Hubbel Company, Chicago, who spoke on "Siberia Before the Revolution," and Captain de Sumichrost of the British Army, whose subject was "The France We Are Going To." As a result of efforts to promote games among the soldiers, indoor baseball, volley ball, tennis, checkers, chess, etc., have been played extensively, the outfits for which are provided by the association. Y. M. C. A. branches have also been established at the other headquarters of the railway regiments with like results, as described elsewhere in this issue.

The St. Louis railway regiment, the Second Reserve Engineers, is in camp on the right bank of the Mississippi river near St. Louis. United States Engineer Department houseboats are being used for quarters instead of tents. Ample drill grounds are adjacent. Arrangements have been made for the installation of shower baths, lights and water supply from the city.

The New York regiment is in camp at Fort Totten on Long Island, and the Philadelphia regiment is quartered in the Museum building at Philadelphia.

Samuel M. Felton

Mr. Felton, under whom the nine regiments have been organized, is a railroad executive of long and wide experience. He has been continuously in railway service since 1873, and has been a prominent figure in the transportation field during that time. Among the important offices he has filled are general superintendent of the Pittsburgh, Cincinnati & St. Louis; first vice-president, in charge of the traffic and operating departments of the New York, Lake Erie & Western; president of the East Tennessee, Virginia & Georgia; president and receiver of the Cincinnati, New Orleans & Texas Pacific; president of the Alabama Great Southern and the Chicago & Alton; chairman of the board of directors of the Tennessee Central; president of the Mexican Central; president and receiver of the Pere Marquette, and president of the Chicago Great Western. As receiver of the C. N. O. & T. P., during the Spanish-American war, he handled the movement of 107,755 troops between Cincinnati, Ohio, and concentration points at Lexington, Ky., and Chattanooga, Tenn.,—more men than were transported by any other railroad, nearly one-half of all who were mobilized for service, and approximately twice as many as actually engaged in hostilities in Cuba.

In our last great war, the Civil war, Mr. Felton's father, S. M. Felton, played an important part as president of the Philadelphia, Wilmington & Baltimore Railroad, which, for a time, was the only line open from the North to Washington. In this connection he participated in many stirring incidents. In one case, early in 1861, southern sympathizers formed secret organizations in Baltimore for the purpose of burning the bridges between Baltimore and the North to cut off communication with Washington. Mr. Felton learned of the movement through loyal employees, and sent for Allan Pinkerton to investigate the machinations of the conspirators. Pinkerton learned that these organizations not only planned to destroy the bridges but to assassinate Lincoln as he passed through the city on the Northern Central. In response to urgent pleas by Mr. Felton, Lincoln was taken from Harrisburg, Pa., by special train to Philadelphia according to a carefully arranged plan and, taking a Philadelphia, Wilmington & Baltimore train to Washington, passed through Baltimore unsuspected and undisturbed.

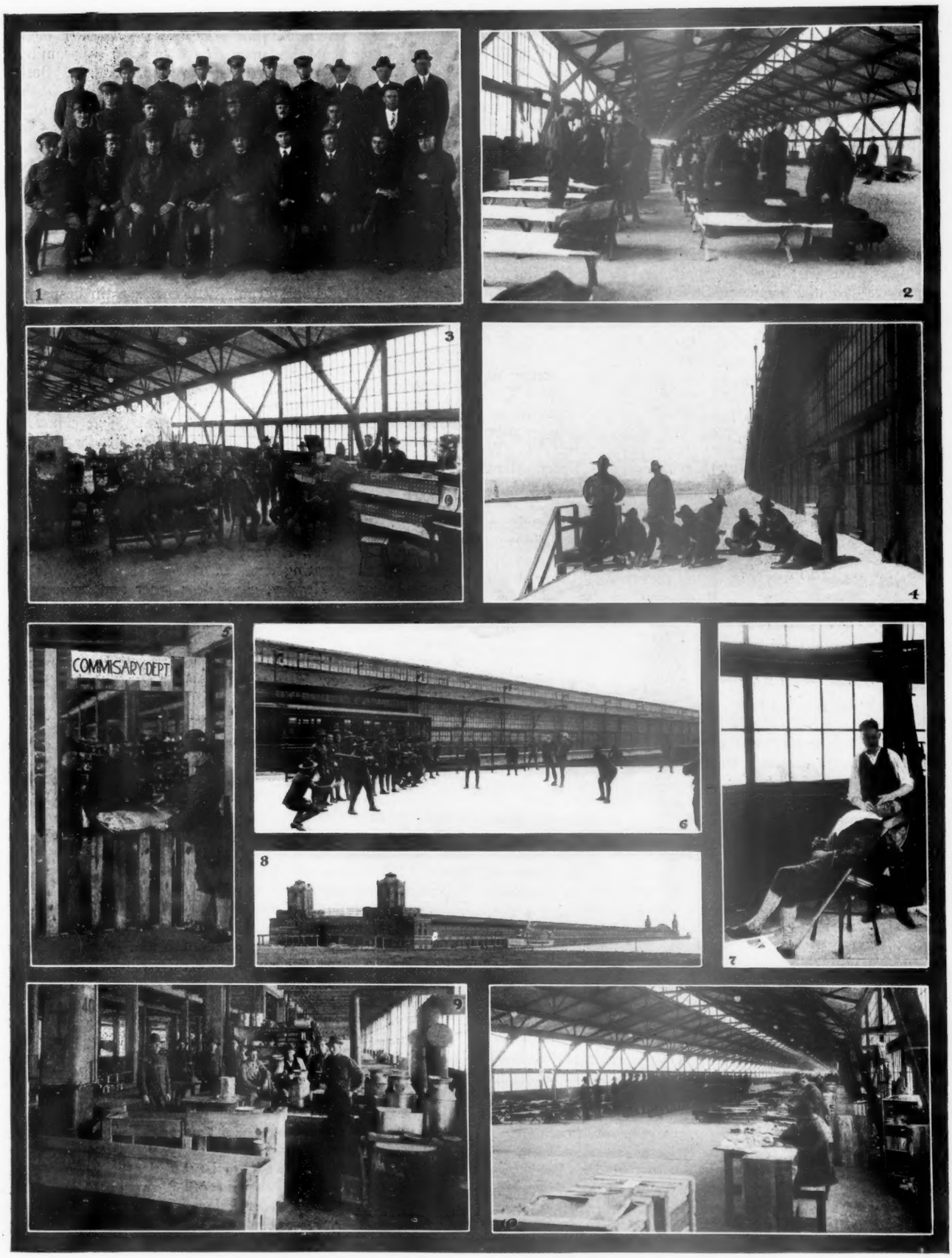
Personnel: First Regiment

The personnel of the officers of the nine regiments has not yet been completely filled, but in the main it is as follows:

The officers of the First regiment (construction), New York, will probably be as follows: Colonel, C. H. McKinstry; lieutenant-colonel, William B. Parsons, consulting engineer; captain adjutant, X. H. Price; captain quartermaster, G. H. Gifford; captain engineer, John D. Irving; major first battalion, Arthur S. Dwight; captain adjutant, C. R. Hulsart; major second battalion, R. S. Buck; captain adjutant, Charles B. Drew. The captain of Company A is John P. Hogan; first lieutenant, J. M. Marshall, Jr.; first lieutenant, E. K. Carley; second lieutenant, T. W. Toerner. The captain of Company B is Harold W. Hudson; first lieutenant, B. R. Value; first lieutenant, Jas. J. Lippincott; second lieutenant, C. M. Anderson, superintendent of safety, Nashville, Chattanooga & St. Louis, Nashville, Tenn. The captain of Company C is A. Maxwell; first lieutenant, Wm. T. Rossell; first lieutenant, Herbert A. Bream; second lieutenant, H. L. Hoyt, general ticket agent, Boston, Revere Beach & Lynn, Boston, Mass. The captain of Company D is Willard T. Chevalier; first lieutenant, Leonard Hibbard; first lieutenant, J. W. Maitland; second lieutenant, A. L. Cone. The captain of Company E is H. W. Holland; first lieutenant, Paul McLoud; first lieutenant, Reginald M. F. Townsend; second lieutenant, Geo. D. Dixon, Jr. The captain of Company F is Charles J. Joly; first lieutenant, Morris Caldwell; first lieutenant, Robt. J. Colgan; second lieutenant, Enoch N. Holstrom.

Second Regiment

The roster of the Second Regiment (operating), St. Louis, will probably consist of the following: Curtis McD. Townsend, of the regular army; lieutenant-colonel, H. H. Adams, formerly president Kansas City Terminal; captain adjutant, C. L. Hall, of the regular army; captain quartermaster, James W. Skelly, U. S. assistant engineer; captain engineer, H. S. Phillips, general superintendent, Abilene & Southern, Abilene, Tex.; major first battalion, F. G. Jonah, chief engineer, St. Louis-San Francisco, St. Louis; captain adjutant, Wm. J. Millard, formerly in the maintenance of way departments of the Cleveland, Cincinnati, Chicago & St. Louis and the St. Louis-San Francisco and chief engineer of Belgian expedition up the Congo river in Africa in 1910; major second battalion, John A. Laird, consulting engineer; captain adjutant, W. W. Burden. The captain of Company A is Fred W. Green, assistant to first vice-president, St. Louis-San Francisco, St. Louis; first lieutenant, Clarence C. Brown, maintenance of way department, St. Louis-San Francisco; first lieutenant, H. H. Downes, manager of the St. Louis (Mo.) branch of the Buffalo Forge Company; second lieutenant, John G. Reilly. The captain of Company B is Fred E. Foster; first lieutenant, J. H. Brooking, assistant engineer, St. Louis-San Francisco, St. Louis; first lieutenant, R. W. Queal, construction engineer, The Foundation Company, St. Louis; second lieutenant, John J. Callahan, valuation department, St. Louis-San Francisco, St. Louis. The captain of Company C is Arthur M. Dunaway; first lieutenant, Chas. S. Johnson; first lieutenant, R. B. Albaugh. The



(1) Officers of the Regiment. (2) Making Up Beds. (3) Y. M. C. A. Qua rters. (4) Practice in Map Drawing. (5) A Section of the Commissary Department. (6) A Period of Relaxation—Indoor Baseball. (7) The Regimental Barber at Work. (8) An Exterior View of the Municipal Pier on which the Regiment Is Quartered. (9) A Company Kitchen. (10) Company E and Its Headquarters.

Photographs of the Third Reserve Engineers' Regiment in Camp at Chicago

captain of Company D is Paul McGeehan, senior civil engineer, valuation division, Interstate Commerce Commission, Kansas City, Mo.; first lieutenant, Irwin E. Burks, draftsman, valuation department, St. Louis-San Francisco; first lieutenant, A. W. Galbraith, assistant engineer, Pennsylvania Lines, St. Louis; second lieutenant, Robert L. Meston. The captain of Company E is Harrison Pittman, U. S. junior engineer, St. Louis; first lieutenant, H. F. McFarland, assistant engineer of bridges, St. Louis-San Francisco, St. Louis; first lieutenant, Geo. R. Koeln, formerly city engineer of St. Louis; second lieutenant, R. F. Ragland, assistant engineer, Wabash. The captain of Company F is F. T. Kennedy, mechanical engineer, United Railways of St. Louis; first lieutenant, S. M. Smith, assistant engineer, bridge department, Wabash; first lieutenant, F. D. Nash, pilot engineer, valuation department, St. Louis-San Francisco.

Third Regiment

The present roster of officers of the Third Regiment (operating), Chicago, is as follows:

Colonel, W. C. Langfitt, of the regular army; lieutenant-colonel, Nathaniel L. Howard, division superintendent, Chicago, Burlington & Quincy, Hannibal, Mo.; captain adjutant, R. D. Black, of the regular army; captain quartermaster, Francis W. Taylor; captain engineer, T. W. Fatherson, engineer maintenance of way, Chicago Great Western, Des Moines, Iowa; major, first battalion, C. L. Bent, inspector passenger train and station service, Illinois Central, Chicago; captain adjutant, W. G. Arn, assistant engineer maintenance of way, Illinois Central, Chicago; major second battalion, Chas. Lewis Whiting, division superintendent, Chicago, Milwaukee & St. Paul, Lewistown, Mont.; captain adjutant, C. E. Carson, superintendent, Ft. Dodge, Des Moines & Southern, Boone, Iowa. The captain of Company A (Illinois Central) is John M. Walsh, terminal superintendent, Memphis, Tenn.; first lieutenant, F. P. Nash, general foreman of shops, Palestine, Ill.; first lieutenant, George T. Sheehan, yardmaster, New Orleans, La.; second lieutenant, J. W. Kern, Jr., supervisor, Mounds, Ill. The captain of Company B (Rock Island Lines) is Victor H. Hagelberger, trainmaster, Bureau, Ill.; first lieutenant, Frank Adelbert Parker, chief despatcher, Des Moines, Iowa; first lieutenant, Stephen E. Mueller, general foreman locomotive department, Cedar Rapids, Iowa; second lieutenant, William E. Haberlaw, roadmaster, Rock Island, Ill. The captain of Company C (Chicago Great Western) is E. E. Stoup, trainmaster, Des Moines, Iowa; first lieutenant, Sidney V. Rowland, assistant superintendent, Red Wing, Minn.; first lieutenant, R. W. LeBaron, examiner of joint facilities; second lieutenant, Earl Edward Deyo, yardmaster, Oelwein, Iowa. The captain of company D (Chicago, Milwaukee & St. Paul) is Alexander Young, district master mechanic, Milwaukee, Wis.; first lieutenant, Thomas P. Horton, train despatcher, LaCrosse, Wis.; first lieutenant, Frank T. Lee, locomotive engineer, Portage, Wis.; second lieutenant, Fred W. Sawtelle, roadmaster, Horicon, Wis. The captain of Company E (Chicago & North Western) is Guy A. Holmes, assistant superintendent at East Clinton, Ill.; first lieutenant, E. H. Shaughnessy, trainmaster, Chicago; Edward Schultz, master mechanic, Chicago; second lieutenant, Walter S. Johnston, chief train despatcher, South Pekin, Ill. The captain of Company F (Atchison, Topeka & Santa Fe) is Leroy Overpeck, general yardmaster, Emporia, Kan.; first lieutenant, L. Fred Von Blucher, roundhouse foreman, Galveston, Tex.; first lieutenant, Grove C. Kennedy, chief despatcher, Beaumont, Tex.; second lieutenant, Sidney S. McConnell, clerk in superintendent's office, Emporia, Kan.

Fourth Regiment

The present personnel of the Fourth regiment (operating), Boston, Mass., is as follows:

Colonel, W. P. Wooten; captain adjutant, Layson E. Atkins; captain engineer, Ralph Bradley, supervisor of fuel service, Boston & Maine; major first battalion, Benjamin W. Guppy, engineer of structures, Boston & Maine, Boston, Mass.; captain adjutant, Albert B. Cole, general freight and passenger agent, Monongahela Valley & Traction Company, Fairmont, W. Va. The captain of Company A (Boston & Maine) is Charles Wesley Lewis, track supervisor, Boston & Maine, Portsmouth, N. H.; first lieutenant, J. H. Hustis, Jr., yardmaster, New York Central; first lieutenant, Louis Franklin Gilson, train despatcher, Boston & Maine; second lieutenant, Otis B. Ruggles, supervisor signals, Boston & Maine, Salem, Mass. The captain of Company B (Boston & Maine) is Frank C. Pelletier, yardmaster, Boston & Maine; first lieutenant, A. T. Hoyle, night yardmaster, Boston & Maine; first lieutenant, Frank W. Rourke, train despatcher, Boston & Maine; second lieutenant, Charles J. Ferguson, president's office, Boston & Maine. The captain of Company C (Maine Central) is W. L. Post, assistant engineer, Maine Central; first lieutenant, David Edwin Hayes, train despatcher, Maine Central; first lieutenant, Robert Sturgion, engineman, Maine Central; second lieutenant, B. B. Whitney, assistant road master, Maine Central. The captain of Company D (Boston & Albany) is R. G. Henderson, chief clerk to general superintendent, Boston & Albany; first lieutenant, E. H. Smith, division master mechanic, Boston & Albany; first lieutenant, E. D. Collamer, assistant track supervisor, Boston & Albany; second lieutenant, George M. Trumble, train despatcher, Boston & Albany. The captain of Company E (New Haven) is Louis De B. Lovett, special representative operating department, New Haven; first lieutenant, James S. Hawley, chief despatcher and trainmaster, New Haven; first lieutenant, Alonzo T. Hoyle; second lieutenant, James A. Cunningham. The captain of Company F (New Haven) is Frank P. Paten, general yardmaster, New Haven; first lieutenant, John Michael Townsend, construction engineer, New Haven; second lieutenant, J. O. Tabor, civil engineer.

Fifth Regiment

The following will probably constitute the officers of the Fifth regiment (construction), Pittsburgh, Pa.:

Colonel, Edgar Jadwin; captain adjutant, B. B. Somerville, formerly principal assistant engineer, Pennsylvania Lines; captain quartermaster, W. I. Pillans; captain engineer, Ried Povoke; major first battalion, E. A. Gibbs; captain adjutant, Richard Brooks; major second battalion, Elmer H. Hiles, secretary, Engineers' Society of Western Pennsylvania, Pittsburgh, Pa.; captain adjutant, I. S. Patterson. The first lieutenant of Company A is Theo. H. Schoeph; the other first lieutenant, Lee C. Morganroth; second lieutenant, Jas. F. Beattie, Jr. The captain of Company B is James L. Taylor, Jr., assistant engineer, Pennsylvania Lines, Pittsburgh; first lieutenant, Richard E. J. Summers; first lieutenant, Everett E. Archibald; second lieutenant, W. M. McKee. The captain of Company C is E. B. Butcher; first lieutenant, George J. Richers, assistant master mechanic, Pennsylvania, Verona, Pa.; first lieutenant, Thurlston Scott; second lieutenant, D. C. Martin, supervisor of track, New York Central, Elyria, Ohio. The captain of Company D is C. B. Stanton; first lieutenant, W. J. Gorman; first lieutenant, Lester C. McAndlish; second lieutenant, R. P. Pennoyer. J. G. Shaw is first lieutenant of Company E; J. W. Bickford, the other first lieutenant; S. E. Emmons, second lieutenant. The captain of Company F is E. D. Walker; first lieutenant, C. L. Harrod; first lieutenant, Edward E. Duff, Jr.; second lieutenant, Frederick P. Karnes.

Sixth Regiment

The probable officers of the Sixth Regiment (construction), Detroit, Mich., are as follows:

Colonel, Harry Burgess, corps of engineers, U. S. army;

lieutenant-colonel, George H. Webb, chief engineer, Michigan Central, Detroit; captain adjutant, Raymond F. Fowler, corps of engineers, U. S. army; captain quartermaster, Frank R. Weeks, engineer and contractor, Detroit; captain engineer, Sam S. Magoffin; major first battalion, John H. Poole; captain adjutant, T. L. Huston; major second battalion, Samuel A. Robertson, president, San Benito & Rio Grande Valley Railroad of Texas, San Benito, Tex.; captain adjutant, Nettleton Neff, superintendent, Pennsylvania Lines, Akron, Ohio. The captain of Company A is Ernest Gonzenbach, formerly general manager, Empire United Railways, Syracuse, N. Y.; first lieutenant, Frank W. Brooks, Jr., assistant general superintendent, Detroit United Railway; first lieutenant, Chas. G. Williamson, instrument man, Michigan Central; second lieutenant, Laurens Hammond, mechanical engineer, McChord Manufacturing Company, Detroit, Mich. The captain of Company B is Andrew P. Wenzell, consulting engineer; first lieutenant, E. I. Van Antwerp, resident engineer, Grand Trunk, Detroit; first lieutenant, Henry Duncan Moore; second lieutenant, Thomas W. P. Livingstone. The captain of Company C is David A. Daly; first lieutenant, John C. W. Hinshaw; first lieutenant, A. R. Masters; second lieutenant, Ernest Grey. The captain of Company D is James H. Grier; first lieutenant, B. F. Pontey, assistant engineer, Michigan Central; first lieutenant, N. N. Barber; second lieutenant, Otto C. Randolph, formerly in the bridge department of the Michigan Central. The captain of Company E is George A. Lewis, manager of a construction company; first lieutenant, E. P. Grey; first lieutenant, Earl Ladd Goodspeed, consulting engineer; second lieutenant, Barrett Montfort. The captain of Company F is Harry Nye Williams, superintendent Chicago division, New York, Chicago & St. Louis, Chicago; first lieutenant, Harley L. Swift, engineering department, Mahoning & Shenango Railway & Light Company; first lieutenant, Myron K. Blackmer, assistant to vice-president, Midwest Refining Company, Denver, Colo.; second lieutenant, H. W. Skinner, engineer, Bates & Rogers Construction Company, Cleveland, Ohio.

Seventh Regiment

The following will probably comprise the officers of the Seventh regiment (construction), Atlanta:

Colonel, John S. Sewell; lieutenant colonel, Charles Gates Dawes, president, Central Trust Company, Chicago; captain adjutant, P. C. Bullard; captain quartermaster, Wm. Belford Ryan; captain engineer, E. D. Taliferro; major first battalion, W. G. Atwood, assistant district engineer, Interstate Commerce Commission, Chattanooga, Tenn.; captain adjutant, Wm. Bowdoin Causey; major second battalion, Edward B. Cushing, assistant general manager, Southern Pacific Lines, Houston, Tex.; captain adjutant, T. E. Grafton. The captain of Company A is D. S. Adams; first lieutenant, John Dow Farrington, trainmaster, Chicago, Burlington & Quincy, Ottumwa, Iowa; first lieutenant, Frank Elmaker Lawrence; second lieutenant, Earl David Yarcho. The captain of Company B is Denise Burkhalter, first lieutenant, G. B. Howard; first lieutenant, J. C. Roop; second lieutenant, Wm. Louis Heinze. The captain of Company C is C. S. Coe, superintendent maintenance of way, Florida East Coast, St. Augustine, Fla.; first lieutenant, R. M. Lawton, assistant engineer construction, New York, New Haven & Hartford, New Haven, Conn.; first lieutenant, H. G. Halleck; second lieutenant, J. A. Hubbard. The captain of Company D is F. E. Estes; first lieutenant, C. R. Armstrong; first lieutenant, Conway R. Howard; second lieutenant, R. S. Welch. The captain of Company E is W. F. Hutson, assistant superintendent, Southern Pacific, Houston, Tex.; first lieutenant, F. S. Jones; first lieutenant, Everette A. Craft, assistant engineer, Chicago & Eastern Illinois, Salem, Ill.; second lieutenant, C. A. Henderson. The captain of Company F is John W. Mulhern, formerly superintendent of the Chicago Great Western at St. Paul, Minn.; first lieutenant, Rudolph Mitchell, assistant superintendent, New Orleans, Texas & Mexico, DeQuincy, La.; first lieutenant, Julian Allen Dickinson; second lieutenant, Robert L. James.

Eighth Regiment

The officers of the Eighth Regiment (construction), San Francisco, will probably include the following:

Colonel, J. B. Cavanaugh; lieutenant-colonel, J. R. Holman, formerly chief engineer, Oregon-Washington R. R. & N. Co.; captain adjutant, J. B. Cress; captain quartermaster, Tom Ward; major first battalion, Joseph White Williams, chief engineer construction, Northwestern Pacific, San Francisco; captain adjutant, Paul Reisinger, superintendent Arizona & New Mexico, Clifton, Ariz.; major second battalion, George M. Rice; captain adjutant, William Howard Nelson. The captain of Company A is Norton Russel; first lieutenant, Harry L. Kile, roadmaster Western Pacific, Portola, Cal.; first lieutenant, Arthur T. Schunck; second lieutenant, Thomas Hamilton Darrow. The captain of Company B is Bert J. Simmons, division engineer, Atchison, Topeka & Santa Fe Coast Lines, Needles, Cal.; first lieutenant, Alsa Chester Howard; first lieutenant, Donald Ellis Rhivers; second lieutenant, John Graham Howell. The captain of Company C is Charles Calhoun Cragin; first lieutenant, Emil F. Morest; first lieutenant, Hugh L. Wiley; second lieutenant, Seymour Husted Phelan. The captain of Company D is Harold W. Young; first lieutenant, Tom W. Saul, division engineer, Oregon-Washington R. R. & Nav. Co., Portland, Ore.; first lieutenant, Albert F. Chittenden; second lieutenant, Walter C. Sadler. The captain of Company E is Kenneth Houser; first lieutenant, John T. Dovey; first lieutenant, George Albert Kendrick; second lieutenant, Don H. Evans. The captain of Company F is Louis A. Nutter; first lieutenant, Alfred Bream Cutter; first lieutenant, Charles Kitch Smith; second lieutenant, Preston B. Delano, general manager California Central, Grants Pass, Ore.

The Ninth Regiment

The Ninth Regiment (shop), Philadelphia, will probably be composed of the following officers:

Colonel, Herbert D. Deakyne; lieutenant-colonel, H. H. Maxfield, superintendent motive power; Western Pennsylvania division, Pennsylvania, Pittsburgh; captain adjutant, William F. Tompkins; captain quartermaster, C. R. Rogers; captain engineer, Van R. C. King, district superintendent, Atlantic Coast Line, Wilmington, N. C.; major first battalion, Charles D. Barrett, master mechanic, Pennsylvania, Sunbury, Pa.; captain adjutant, Charles P. O'Connor; major second battalion, Charles S. Gaskill, master mechanic, Pennsylvania, Baltimore, Md.; captain adjutant, George W. Whybark. The captain of Company A is George W. Butts; first lieutenant, William B. Rudd, first lieutenant, Robert R. Meigs; second lieutenant, McClure Fahnestock. The captain of Company B is E. B. Whitman; first lieutenant, Frank A. Wighman; first lieutenant, William B. Stevens; second lieutenant, Charles G. Brown. The captain of Company C is Ben W. Kline, electrician Pennsylvania, Williamsport, Pa.; first lieutenant, Floyd V. De Haven; first lieutenant, Christen K. Steins; second lieutenant, A. G. Moler. The captain of Company D is John McDonough, assistant shop superintendent, Baltimore & Ohio, Baltimore; first lieutenant, Clarence G. Boffemyer; first lieutenant, Alba B. Johnson; second lieutenant, Joseph G. Sheaffer. The captain of Company E is F. S. Robbins, assistant master mechanic, Pennsylvania, Pittsburgh; first lieutenant, Frank R. Fitzpatrick; first lieutenant, Thaddeus M. Mallam, second lieutenant, Don C. Menick. The captain of Company F is C. F. Huff; first lieutenants, James J. Maguire and William Welch; second lieutenant, Edwin D. Hagerty.

Railroad Y. M. C. A. Wartime Activities

This Organization Has Planned an Aggressive Campaign of Service to Soldiers on Guard and in Transit

By John F. Moore

General Secretary, Railroad Department, International Committee of Young Men's Christian Associations.

NEVER in the history of our country have railroads and railroad employees occupied so important a place in public appreciation as in these war days. Never before has the Railroad Young Men's Christian Association faced an opportunity as great or a crisis as immediate and pressing as today.

That transportation will play a vital part in the great world struggle is beyond question. It is one of the indispensable factors, without which battles become impossible and victory only a dream. Much of the marvelous strength of Germany is due to the wonderful intricate network of railways behind her lines. But for this advantage the Central empires would before this have known defeat and the Allies probably have ridden in triumph through the streets of Berlin.

If the American railroads, through scientific co-ordination and increased efficiency, can succeed in transporting the products of the farm and the output of factories safely and speedily across our continent to cities and seaports, they will help in winning a victory as great as any won by arms on ensanguined fields of battle far away.

When war became certain, the United States Government promptly recognized that if victory was to be won it would be due to the efficiency of four equally related and equally indispensable factors: The soldiers, the farmers, the men of industry, and the American railroads. And it further realized that, parallel with these factors, with a practical service whose tendency would be to strengthen them all, was the Young Men's Christian Association with its wonderful war record during the Spanish campaign and later on the Texas border.

John F. Moore

That the above statement is conservative is indicated by the following executive order issued by President Wilson:

President Wilson's Executive Order

"The Young Men's Christian Association has, in the present emergency, as under similar circumstances in the past, tendered its services for the benefit of enlisted men in both arms of the service. This organization is prepared by experience, approved methods and assured resources to serve especially the troops in camp and field. It seems best for the interest of the service that it shall continue as a voluntary civilian organization; however, the results obtained are so beneficial and bear such a direct relation to efficiency, inas much as the association provision contributes to the happiness, content and morale of the personnel, that in order to unify the civilian betterment activities in the Army, and further the work of the organization that has demonstrated its ability to render a service desired by both officers and men, official recognition is hereby given the Young Men's Christian Association as a valuable adjunct and asset to the service. Officers are enjoined to render the fullest practicable assistance and co-operation in the maintenance and extension of the association both at permanent posts and stations and in camp and field. To this end attention of officers is called to the precedent and policy already established."

Soon after the declaration of war a conference of Young Men's Christian Association leaders in all its departments, including city, rural, railroad and industrial, resulted in the appointment of a War Work Council of more than one hundred representative American citizens located in different sections of the country. This War Work Council, of which William Sloane is chairman and John R. Mott (general secretary of the International Committee and now on the Russian Commission) is general secretary, appointed, among other sub-committees, one on transportation, composed at present of the following: Dr. John P. Munn, A. M. Schoyer, Finley J. Shepard, W. A. Harriman, G. W. Brown, W. E. S. Griswold and Elisha Lee.

The sub-committee on Transportation of the War Work Council of the Young Men's Christian Association, co-operating with the Railroad Department of the Young Men's Christian Association, has outlined the following tentative program:

What the Railroad Y. M. C. A. Proposes to Do

First—To keep the present work of the Railroad Young Men's Christian Association up to the highest possible standard of efficiency and to increase the number of railroad associations and the measure of their usefulness, wherever need requires or opportunity offers. It is the judgment of this committee that any policy of retrenchment in the work of this useful organization at this time would be unwise to the point of folly. Railroads are now adjusting their service to the requirements of unusual days. In all human probability they will be taxed to the maximum and will not only require the highest form of service from former and present employees, but will also need groups of new men for whose welfare the Association must make adequate provision.

Second—To render service to the large number of soldiers now under what might be termed "railroad auspices"—as, for example, the men guarding railroad stations, bridges, tunnels, and similar property. These men are, as a rule, located in camp centers in or near railroad communities, details being sent from these centers for shorter or longer periods of service on patrol duty at isolated and desolate points. While on such duty these men are without the stimulus, numbers and inspiration of camp life. Often they are called upon to face loneliness and endure discomfort which thoughtfulness on the part of the railroads and the Railroad Young Men's Christian Association might reduce to a minimum. To such men who for the time being are, in a sense, railroad men in khaki, since they are serving the country by protecting railroad interests, the Railroad Young Men's Christian Association sends secretaries or carefully selected representatives with cheer and hand-shake, distributing attractive literature and performing any reasonable

service. These association men carry with them to even the remotest outposts an expression of the interest and appreciation of railroad corporations in the men who, as sentries, faithfully perform the dreary and monotonous work of patrolling tunnels, bridges, and rights-of-way.

On some railroad systems, as, for example, the Chesapeake & Ohio, the Railroad Young Men's Christian Associations are undertaking a system-wide endeavor along this line, each of the twelve associations on that road assuming responsibility for a given territory, arranging to have delegates visit the men at all outposts from Richmond to Cincinnati. In some instances where it proved difficult to reach the men, the company has co-operated in making it possible for secretaries to visit the soldiers guarding property remote from camp centers. It is difficult to over-emphasize what a visit of this nature may mean to a man who has been spending weary hours of pacing as a sentry, lest harm befall some tunnel or bridge. Such men work in shifts and, therefore, there are always some not immediately on duty, who are free to chat and ready to respond to fellowship and sympathy.

Third—To render service also to groups of soldiers who are camped together in railroad centers where railroad associations are in operation. In many instances companies have been located for weeks or months at some given point. To such companies the railroad associations are extending a cordial invitation to make the association building their headquarters during leisure hours. The men are advised that the khaki is equivalent to a membership ticket; that so far as is consistent with the association's responsibility to railroad men the baths and restaurant are at their disposal, and that they will gladly be furnished stationery and tables to write letters to the home-folk.

To illustrate: Early in April several companies of the Thirteenth Regiment National Guard came to Sunbury, Pa., where the Railroad Association conducts a successful work. The association had a representative ready to meet the troop trains and to extend an invitation to the soldiers to make themselves at home in the Association while in that city. No fewer than 2,000 of the militia visited the Sunbury building that afternoon and evening, using freely the privileges, and finding the shower baths especially welcome.

In Ohio, at Collinwood, the Association keeps in close touch with a camp of 22 soldiers located close to its building, composed of men guarding bridges and buildings in that district. To these men their uniform is their ticket, entitling them to full privileges. The secretary also visits their camp bringing cheer and comfort.

A Letter of Appreciation

The following letter will indicate how much officers and men appreciate attention of this nature, rendered by a Railroad Young Men's Christian Association to men guarding railroad property:

> I take this method of thanking the R. R. Y. M. C. A. through you, their secretary, for the cordial manner in which we have been treated by the local Y. M. C. A.
>
> My command arrived at Clifton Forge, Va., with young men in the ranks who had never been away from home before, everything strange and new. But imagine how pleasant it was to be received by your local secretary, extending a friendly hand and a cordial invitation to all of us to "Make the R. R. Y. M. C. A. your headquarters"—so homelike, so friendly, that we all felt as though we were among old acquaintances, and that far-away look of the recruits immediately disappeared.
>
> I cannot say too much about your work, for words would fail, and I can only express to you, and all of your associates, that this Command, to a man, are perfectly delighted with your work and all men connected with it, as far as we have been fortunate enough to meet.
>
> G. D. REYNOLDS, Captain.
> Comdg. Co. E, 2nd Va. Inf.

Fourth—Camps are now being formed throughout the country where railroad engineers are being prepared for service abroad. Such a group of men has recently been assembled on the Municipal pier on Grand Avenue in Chicago. The Railroad Y. M. C. A. of that city has provided everything possible in the way of chairs, tables, electricity, games, reading matter, and creature comforts of every kind, putting in charge a group of railroad secretaries who understand the men among whom they work and who will be understood by them. This work is more fully described in the article on another page entitled "Railway Men Organized for Foreign Service." What is being done in Chicago is planned elsewhere.

Other Plans Which Are Being Formulated

The work already specified is now under way. Other plans are also being formulated by which the Railroad Young Men's Chrisian Associations may helpfully serve the million or more soldiers who soon will be in transit from home centers to various concentration camps and later from concentration camps to points of embarkation. While the character and degree of work possible for these men will have to be determined later in the light of then existing conditions and the desire of the Government, it is expected that some, and probably all, of the following forms of service may be rendered:

First—A Railroad Y. M. C. A. secretary traveling, with the approval of the Government, with trains of soldiers as part of the train force, serving the men in every possible manner and having available for them literature, postcards, and stamps.

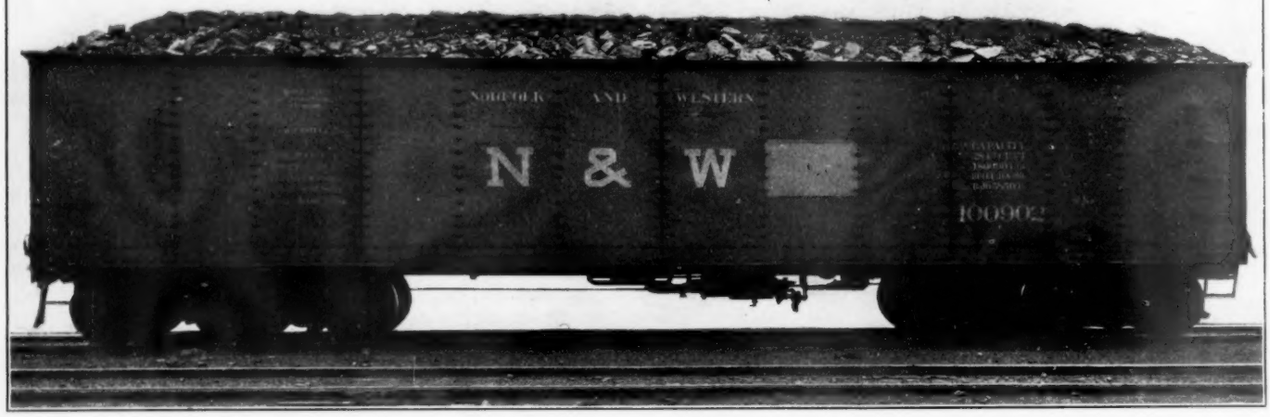
Second—The working out of some plan by which, with the consent of the Government and the railway companies, arrangements may be made with local railroad associations at division points, where troop trains will remain for from fifteen minutes to an hour or more, by which the railroad association may assemble co-operating local forces of men and women in preparing lunches at a reasonable price. Where the stop is not of sufficient length for the men to have lunch locally, provision could be made for box lunches to meet the need.

Third—Where railroad associations are located adjacent to train stops it would often be possible, provided such associations were notified a reasonable time before arrival of a troop train, to make provision for baths for large numbers of the men. This could be done by a preliminary census of all available public baths in the community and occasionally by preparing temporary shower baths, as has already been done by a number of associations—as, for example, Bradford, Ohio—with most gratifying results. Such a provision for the comfort of the men would be a godsend when traveling across country in midsummer or early fall in hot, crowded cars. If it were known a little in advance that a train would stop at a division point for even an hour, such provision could frequently be made.

The railroad department of the Young Men's Christian Association realizes the magnitude of the opportunity confronting it and the difficulties in the way of the consummation of its program. It believes, however, that what it has already done for the railroad men of North America has prepared it to make a far-reaching contribution toward the happiness and welfare of an increasing number of railroad men, of the soldiers now protecting the right-of-way and railroad property of North America and of that larger army of men soon to leave their homes to serve under the stars and stripes on distant fields of battle.

During the months of stress and strain that face our country, the Railroad Young Men's Christian Associations will not prove faithles to the expectations of the railroad companies. the railroad men, and the call of the hour. Its more than five hundred secretaries and its membership of over one hundred and twenty-five thousand railroad men will not be found wanting in the hour when service and sacrifice are the price of national honor. Forms of service may differ, but all associations will gladly and promptly do what is within their power to speed the dawning of a righteous peace following a victory won, not because of lust for conquest or hunger for gold, but because America believes in the eternal principles proclaimed in the Sermon on the Mount by One whose name the Railroad Y. M. C. A. bears.

Heavier Car Loading Would Eliminate Car Shortage



A Norfolk & Western 90-ton Car loaded with 212,000 lb. of Coal

THERE is no other means by which the capacity of America's 250,000 miles of railroad can be so economically and efficiently increased as by heavier carloading. A car loaded to full capacity instead of to half its capacity can be moved with an almost negligible increase in transportation expenses, in maintenance of way expenses, or in expenses of maintenance of equipment. It does not take up any more yard room or any more sidetrack room. A car loaded to full capacity is doubling the capacity of all the facilities used in the transportation of freight as compared with a car loaded only to half of its capacity. At the present time it is yard space, terminal facilities and available cars which are limiting the service which the American transportation system is rendering. Loading cars twice as heavily as they are loaded now simply doubles the service which all of these facilities can render without the necessity for adding to the facilities.

There are a complexity of reasons why the average load of freight per loaded car is less than half of the capacity of the car. Notwithstanding this fact it is apparently the consensus of opinion of the large number of railroad executive officers that have been consulted by the *Railway Age Gazette* that the underlying principle of obtaining heavier carloading is simple. It is the means of bringing about the conditions which will make possible the solution of the problem that is so complicated. Stated in its simplest terms, the result of the investigation which the *Railway Age Gazette* has made and which is based on the experience of a large number of railroad officers dealing with this problem over a series of years, is this: If every shipper and every railroad man having to deal with the loading of cars were, in every single instance, to ask himself if it was not possible to get twice as much into the car which he was loading, or at least a few more tons, and would conscientiously in every individual case try to accomplish this result, the present car shortage could be entirely overcome. Acknowledging that to bring about such a state of mind as this, with every individual having to do with the loading of freight on 250,000 miles of railroad, is an ideal only and not possible of practical attainment, it is nevertheless true that it is worth working for, and even a partial attainment of this end would be of immeasurable advantage to shippers and to the country as a whole.

It is the opinion of the great majority of the railroad men consulted by the *Railway Age Gazette* that individual solicitation of shippers and of railroad agents handling the loading of cars is the most effectual way of getting heavier carloading. Accepting this as indisputable and describing in the following pages some of the methods adopted to make individual solicitation successful, it is pertinent and useful to inquire whether or not under present conditions personal solicitation cannot be supplemented by other methods, such as advertising and circularizing, in such a way as to add immensely to the effectiveness of the present country-wide efforts towards obtaining better freight car loading.

Before going further in this investigation, however, it is proper that a statement of present conditions should be made so that some standard of what 100 per cent loading would be

Railroad and Shipper Must Co-operate

CAPACITY of available equipment is ample even for present needs.

Limitations on heavier carloading because of the nature of the commodity to be loaded are being partly eliminated.

Supply available for shipment at one time may sometimes be held over or combined with other shipments.

Two or three commercial selling units based on average car capacity of 25 years ago can be loaded into a modern car.

Raising present minimums versus persuading shippers to load to full capacity regardless of minimums.

Progress which has been made by individual roads is only a start at what can be done.

can be kept in mind. It is obvious that this 100 per cent standard depends, among other things, on (1) the capacity of available equipment; (2) on the nature of the commodity which is to be loaded into the equipment; (3) on the supply available for shipment; and (4) on the commercial conditions of marketing different products which govern unit shipments of these commodities. It will be noted that the above four considerations omit entirely the one consideration which is paramount to all the others—the need for a desire on the part of shipper and agent to get maximum possible loading.

Equipment Available and Percentage of Utilization

The following table shows average car capacity and average load per loaded car for all of the railways in the United States, 1904 to 1914:

Year	Average capacity (tons)	Average load per car (tons)	Year	Average capacity (tons)	Average load per car (tons)
1904.....	30	17.7	1910.....	36	19.8
1905.....	31	18.1	1911.....	37	19.7
1906.....	32	18.9	1912.....	37	20.2
1907.....	34	19.7	1913.....	38	21.1
1908.....	35	19.6	1914.....	39	21.1
1909.....	35	19.3			

The larger table shows the average capacity and average loading per loaded car for individual large representative roads, 1904 to 1916.

Once again it must be pointed out specificially that car capacity is only one of the four principal factors entering into this problem, so that the fact that the Southern Railway has an average car capacity of 37.66 tons and gets an average carloading of only 15.62 tons does not mean that either shippers or agents on the Southern Railway are not as conscientious and as much interested in heavier carloading as shippers and agents on the Chesapeake & Ohio, with its average capacity of 49.72 tons and its average carloading of 33.98 tons. It may mean merely a difference in the nature of the traffic. One or more, or all three, of the other factors may be relatively far more important than the capacity available, in determining the average load per loaded car.

The task of providing additional capacity is one largely up to the railroads, and the table for all roads in the country and the table for individual roads, even more strikingly, show how well the railroads have performed this task. If all the other three factors had been already as fully considered and as much progress had been made in the last 12 years as has been made with the factor of larger capacity cars, little fault could be found with carloading on American railroads.

Average Capacity and Loading per Loaded Car for Several Representative Roads

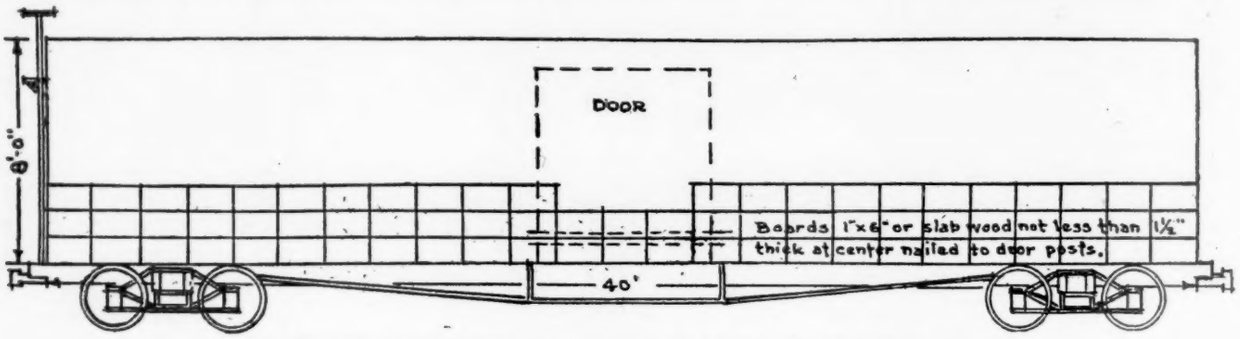
		Average capacity freight cars in service, tons	Average No. tons revenue freight per loaded car mile
Atch., Top. & Santa Fe	1904	26.10	13.71
	1909	30.42	14.70
	1914	34.73	15.75
	1915	35.85	15.95
	1916	36.20	17.14
Atlantic Coast Line	1904	25.33	10.72
	1909	28.40	12.16
	1914	29.53	12.91
	1915	29.97	12.41
	1916	30.17	13.71
Baltimore & Ohio	1904	33.53	20.84
	1909	36.54	21.94
	1914	41.81	25.82
	1915	42.25	27.45
	1916	45.06	28.43
Boston & Maine	1904	22.44	12.66
	1909	27.74	14.17
	1914	31.01	15.85
	1915	31.16	15.79
	1916	31.32	16.99
Central R. R. of N. J.	1904	31.05	24.00
	1909	35.68	27.09
	1914	38.44	27.58
	1915	38.47	27.26
	1916	39.65	28.15
Chesapeake & Ohio	1904	35.81	24.17
	1909	41.44	29.72
	1914	45.24	30.95
	1915	49.05	32.35
	1916	49.72	33.98
Chicago & Alton	1904	31.72	18.20
	1909	39.41	20.64
	1914	41.62	20.37
	1915	41.97	19.52
	1916	41.99	20.84
Chicago & Northwestern	1904	27.95	14.49
	1909	32.46	14.60
	1914	36.93	18.44
	1915	37.85	17.17
	1916	38.72	18.12
Chic., Burl. & Quincy	1904	27.02	15.49
	1909	33.81	17.08
	1914	40.30	19.08
	1915	40.67	19.23
	1916	41.00	20.20
Chic., Mil. & St. Paul	1904	26.33	13.30
	1909	31.67	14.63
	1914	34.65	16.51
	1915	34.50	16.83
	1916	34.94	17.94
Chic., R. I. & Pacific	1904	26.64	13.95
	1909	33.46	15.08
	1914	36.82	15.94
	1915	37.18	16.66
	1916	37.75	16.83
Del., Lack. & Western	1904	29.94	19.83
	1909	32.44	22.24
	1914	33.92	22.79
	1915	34.62	23.06
	1916	34.99	24.03
Erie Railroad	1904	27.86	17.41
	1909	36.77	20.66
	1914	39.95	21.41
	1915	40.28	21.55
	1916	41.11	22.13
Great Northern Ry.	1904	30.75	17.59
	1909	34.87	19.83
	1914	37.31	22.44
	1915	37.36	21.58
	1916	37.68	22.87
Illinois Central Ry.	1904	33.76	15.65
	1909	37.74	18.45
	1914	41.16	20.10
	1915	41.28	20.48
	1916	41.52	20.58
Lehigh Valley	1904	29.64	19.76
	1909	35.73	22.85
	1914	37.38	24.08
	1915	37.56	24.77
	1916	37.92	25.32
Louisville & Nashville	1904	31.94	17.42
	1909	34.38	19.38
	1914	38.51	20.36
	1915	39.11	21.30
	1916	39.45	23.29
Minneapolis & St. Louis	1904	24.69	13.22
	1909	28.13	16.20
	1914	31.22	18.43
	1915	31.29	19.21
	1916	31.98	19.04
Missouri Pacific	1904	27.39	15.42
	1909	31.87	16.13
	1914	33.31	17.54
	1915	33.36	18.16
	1916	33.49	19.05
New York Central	1904	29.56	15.23
	1909	34.33	16.39
	1914	38.64	17.97
	1915	40.35	19.34
	1916	41.10	20.76
N. Y., N. H. & H.	1904	27.24	11.69
	1909	31.83	14.21
	1914	32.84	15.55
	1915	33.02	15.59
	1916	33.07	16.27
Norfolk & Western	1904	33.45	23.13
	1909	41.29	28.02
	1914	48.62	31.60
	1915	49.09	32.57
	1916	49.68	33.77
Northern Pacific	1904	28.46	15.50
	1909	34.35	18.20
	1914	37.25	19.64
	1915	37.49	19.15
	1916	37.65	20.84
Pennsylvania Company	1904	34.30	21.35
	1909	40.75	24.57
	1914	46.21	26.55
	1915	46.57	31.42
	1916	48.95	27.44
Pennsylvania Railroad	1904	36.95	23.81
	1909	43.50	26.99
	1914	47.18	28.10
	1915	47.75	27.10
	1916	49.72	27.93
Pere Marquette	1904	27.64	16.16
	1909	33.40	17.85
	1914	34.08	19.24
	1915	34.14	20.91
	1916	34.32	21.06
Philadelphia & Reading	1904	26.93	.....
	1909	33.01	23.28
	1914	38.00	28.46
	1915	38.97	28.09
	1916	40.52	30.29
St. Louis & San Fran.	1904	27.68	15.88
	1909	27.85	16.96
	1914	38.61	17.83
	1915	38.91	19.34
	1916	39.33	19.45
Southern Pacific	1904	30.80	19.23
	1909	37.75	16.74
	1914	42.95	17.58
	1915	43.61	17.25
	1916	43.98	19.82
Southern Railway	1904	28.75	14.19
	1909	32.81	14.20
	1914	37.05	15.14
	1915	37.13	14.97
	1916	37.66	15.62
Toledo, St. L. & West	1904	26.68	15.34
	1909	31.90	18.43
	1914	33.76	18.65
	1915	36.35	18.51
	1916	37.78	20.00
Union Pacific	1904	29.17	15.60
	1909	36.19	16.14
	1914	43.13	16.40
	1915	44.06	16.36
	1916	45.50	17.88
Wabash Ry.	1904	31.35	15.53
	1909	55.53	17.51
	1914	37.81	18.52
	1915	38.05	18.06
	1916	39.05	19.12

Relation of the Kind of Commodity to Capacity Carloading

A properly designed coal car can be loaded with coal to 10 per cent over its marked capacity. The picture at the beginning of this article shows a 90-ton coal car of the Norfolk & Western loaded with 212,000 lb. of coal. There are other photographs showing 70-ton Pennsylvania gondola cars loaded to their marked capacity, or above, with lumber. On the other hand, in a 40-ft. box car it is possible to load only about one-half of its marked tonnage capacity with potatoes and with fruit and other vegetables. Produce or merchandise packed in crates, which are comparatively easily crushed, cannot be loaded up to the roof of the car, even

when such full loading would still give less than the tonnage capacity of the car. Some commodities require a very considerable open space in the car for ventilation.

Unlike the progress which has been made toward providing greater average freight car capacity, this problem of getting heavier loading for different classes of commodities where the loading is limited by the nature of the commodity has not been very fully studied. Only a few roads have taken their own special problems, in relation to this matter, not as being unsolvable, but as deserving of scientific study. It is the opinion of those who have made such a study carefully and conscientiously that the results are very well worth the effort.



Commercial Selling Unit of Tomatoes—550 Cases, Weighing 37,400 Lb.

Only a few instances can be cited here, but these should stimulate each management to appoint some one or more officers to give this particular question thorough study and make a report thereon.

It has been the general practice in the South to ship watermelons in box cars in four layers only. A fifth layer will crush the melons on the bottom and is therefore impractical. But one road, at least, in the South is putting a double deck in its box cars, which doubles the capacity of the car, as two layers are put on each deck. An additional deck costs in the neighborhood of $5. Think of buying a whole box car for $5!

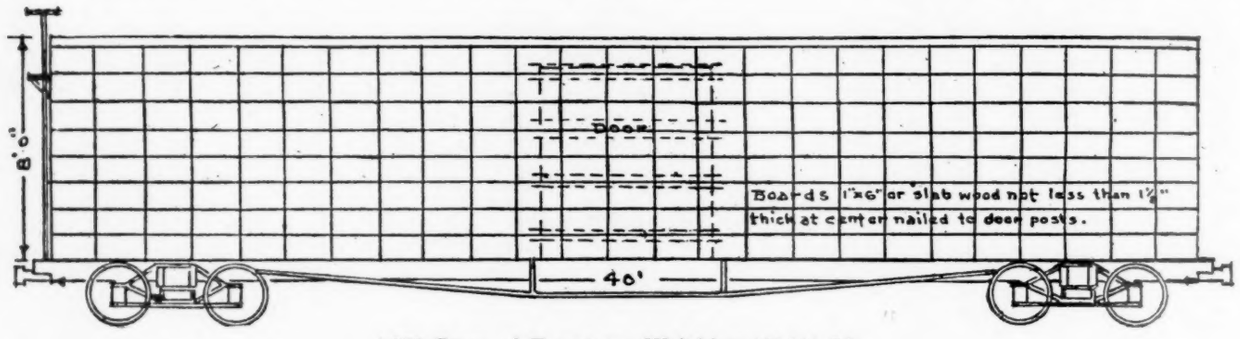
A large number of shippers stack barrels of potatoes in cars horizontally. It is possible to get only a comparatively few tiers of barrels of potatoes lying on their side in a box car; the lower tier will split open long before the cubic capacity of the car is reached. Experiments have shown, however—at least to the satisfaction of one large eastern road—that with the kind of barrels that come on to its line, many more barrels can be put into a box car if the barrels are stood on end. A car arrived at New York a few days ago with 341 barrels and they rode without damage.

In piling sacks of different commodities into a car many shippers have gone on the assumption that the stacks of sacks must be tapered off toward the car door so as not to spill out and many railroads accept this method of loading without question. In a great number of cases a door, or some kind of bars, similar to a grain door, can at a very small cost be installed in box cars into which shipments of sacked material, such as salt or sugar, are to be placed, and double or even triple the freight which can safely and comparatively easily be put into the car. Here is another instance of, in effect, buying a freight car for a few dollars.

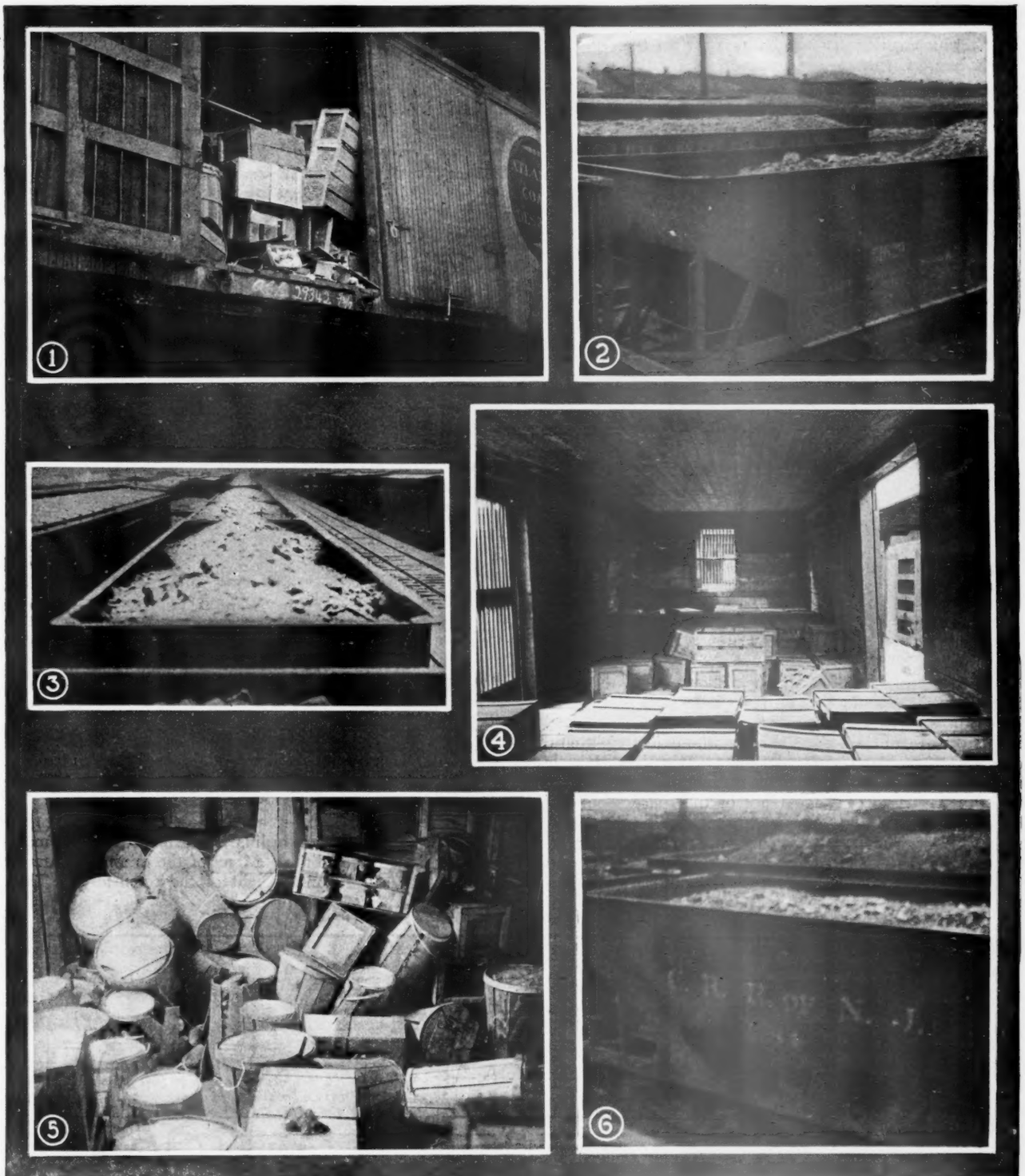
What is the easiest way and the best way to start a campaign to get adopted the reforms which a scientific study of the loading of each commodity shows could and should be undertaken? Here, as in many other cases, the most directly traceable results are obtained by personal solicitation, personal conference, friendly exhortation and firmness in bringing pressure to bear on shippers to make them progressive and scientific in their loading of cars even against their will.

One coal road has had the following very interesting experience: The majority of operators on its lines were nearly as much alive to the necessity of getting heavy carloading as was the railroad management. They were not only willing but anxious to co-operate. In conferences with the higher railroad officers they said with the utmost sincerity that they were loading coal to the full marked capacity of the car, or even to the full 10 per cent allowable overload. From a careful study of its own records and from careful observation of conditions at the mines, the railroad management knew that the operators were not loading their cars to capacity. The railroad company employed a man to go from mine to mine taking pictures of underloaded coal cars just as they were being received by the railroad company, endeavoring in taking these photographs to get car numbers. No figures could have been so convincing. The operators could be shown that car number so-and-so, which his own record showed that he had loaded, was only piled with coal to the top of the sides in the middle and that 10 tons more coal could have been put in each end of that car. The effect has been all that could have been asked for. The operators who believed that they were co-operating fully with the railroad to save cars have been able to increase their carloading by 10 to 20 per cent.

There have been instances where shippers were found deliberately loading the smallest amount of coal that they could

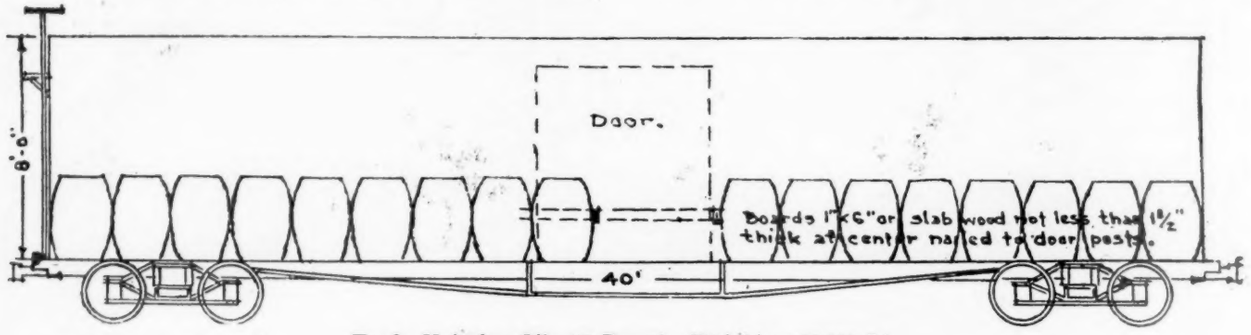


1,500 Cases of Tomatoes, Weighing 102,000 Lb.



(1) What Happened to Fruit and Vegetables When Car Was Not Loaded Full; (2) Poorly Loaded Coal Car; (3) Underloaded Car Leaving the Mine; (4) How Improper Loading of Fruit Is Remedied; (5) Results of Loading Fruit Improperly; (6) Car Loaded at the Mines on the B. & O.

into cars because they were making deliveries on old contracts which called for much lower prices than those now prevailing. On the whole, however, by far the greatest part of the poor carloading was due to lack of supervision. Some of the photographs taken in this campaign are shown with this article. There are other photographs showing various



Trade Unit for Oil—65 Barrels, Weighing 26,650 Lb.

commodities, most of which were taken in the study of the problem which is now being made by the various roads.

Although some of these studies have not been completed, the results so far obtained tend to indicate that increased supervision on the part of railroads as well as shippers will go very far toward finding ways and means of loading commodities to the capacity of the cars—cubical or weight—for each commodity.

When "Quantity to Be Shipped" Is a Factor.

One of the illustrations which is shown herewith is of the interior of a gondola car with a single steel casting in it. The capacity of the car is 50 tons; the weight of the casting is less than three tons. The shipper who paid freight on this casting had nothing else for the same destination. His shipment was limited by the amount of freight which he had to ship to that point. The balance of the space should have been used for another shipment to the same destination or a shipment for another destination in the same direction, holding the shipment up a day or two if necessary to get a load. There is another illustration showing only a portion of a car's capacity being used by a shipment of iron bars. This was all the shipper had to ship. In these particular cases mentioned it might have been difficult to get other freight going in the same direction, but in both cases that would have been the solution.

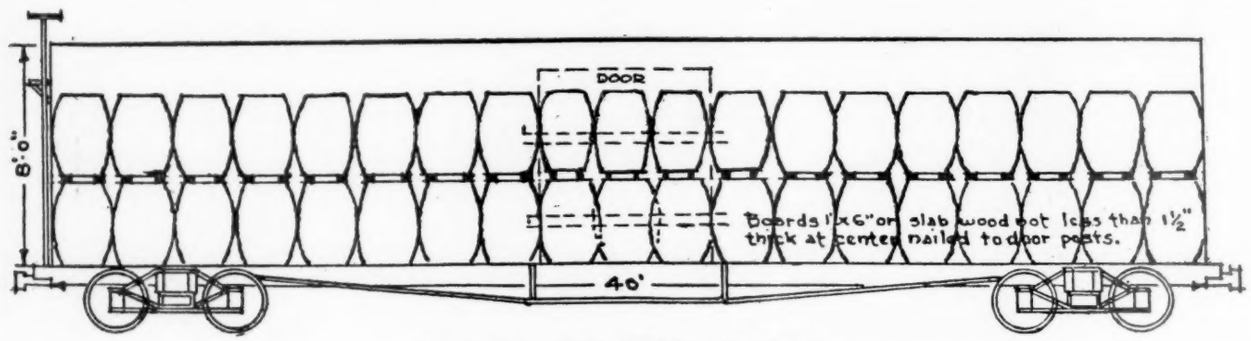
Here again ingenuity and constant supervision are required. Specific instances of what has been done are of comparatively little help, because the chances are that exactly the same combination of circumstances will very seldom recur. To a great extent the railroad will have to depend on the ingenuity and the conscientious supervision of its own officers and agents to combine shipments. Only to a limited extent can the co-operation of shippers be of much help. But even here co-operation comes in. The railroads should point out the way and the shippers should co-operate; both will be benefited. A principal eastern railroad has inaugurated shipping days for less carload freight so as to provide regularity of service for shippers and save sending out partially loaded cars.

Carloading and Selling Units of Commodities

On a great variety of commodities the tariffs in the different freight classifications provide a minimum which will be moved at the carload rate. The following table shows the minimums in the three freight classifications for some representative commodities:

	Official classification	Southern classification	Western classification
Flour	40,000	Any quantity ratings	30,000
Lumber	34,000	30,000	34,000
Dressed meats	20,000	20,000	20,000
Agricultural implem'ts	24,000 per 36-ft. 6-in. car	20,000 per 36-ft. 6-in. car	24,000
Household goods	12,000	20,000	20,000
Furniture, N. O. S.	10,000	12,000	12,000
Wheat	In sacks or bbls., 60,000 In bulk 64,500		60,000

It is obvious that these minimums are far below the capacity of the cars which are ordinarily furnished for the movement of these commodities. Many of the minimums are the same as the selling unit weight of the commodity. Thus, with tomatoes, 550 cases, which weigh only 37,400 lb., are the commercial selling unit; with fertilizer, 250 bags, weighing 42,000 lb., are the selling unit; with sugar, 400 bags, weighing 40,800 lb.; with salt, 536 bags, weighing 53,600 lb.; with cotton, 50 bales, weighing 25,000 lb.



148 Barrels of Oil, Weighing 60,680 Lb.

The selling unit was originally based on the carload. The minimums in use today on American railways represent in many instances the capacity of the freight cars that were in use for the movement of those commodities at the time when the minimums were established.

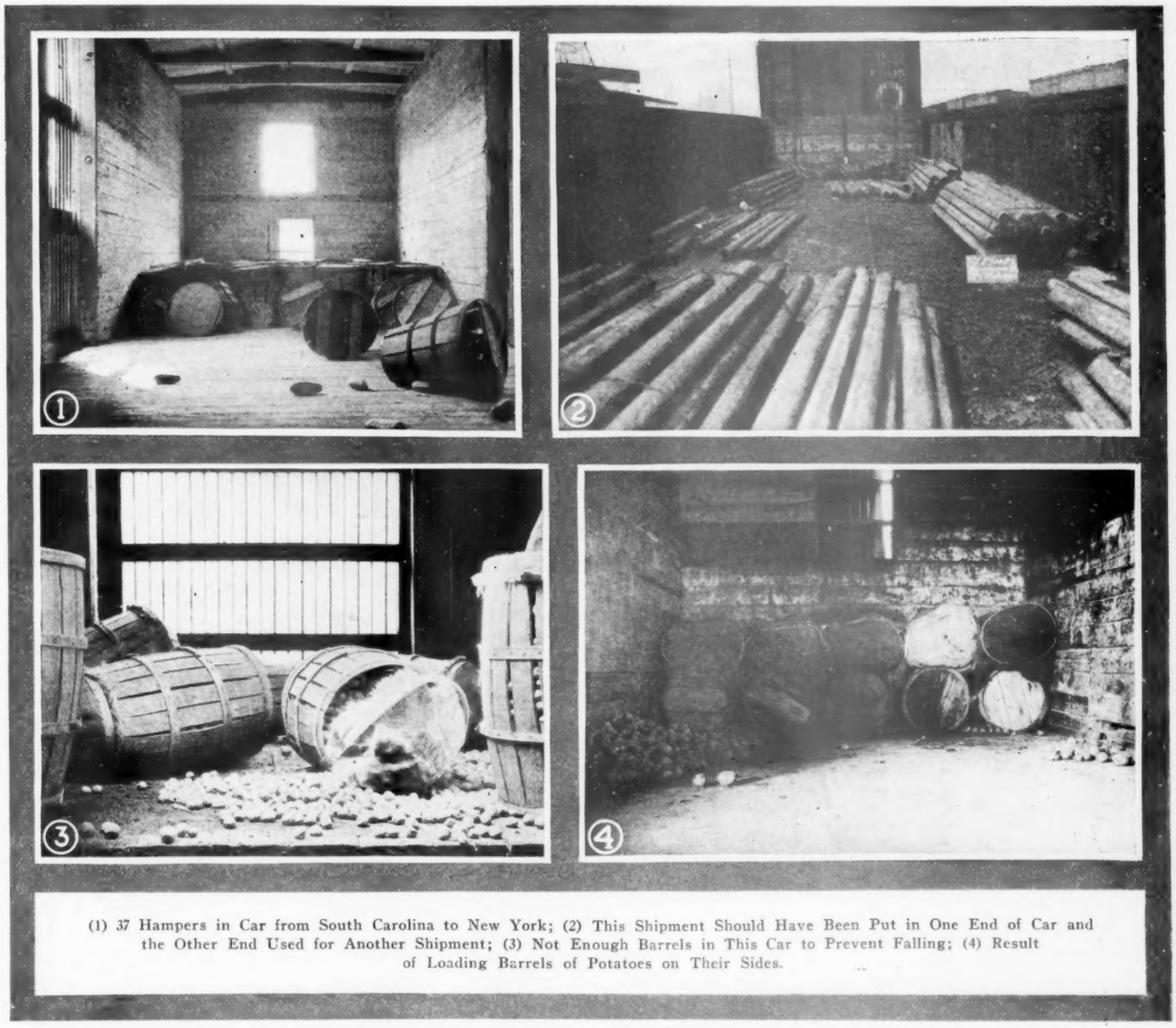
Thus, with sugar, a little over 20 tons represented a fair

percentage of the capacity of the 30-ton car that was in use when the minimum on sugar was established, although even then there may have been cars placed for the loading of sugar with a considerably larger capacity than that. The selling unit was adopted by custom on the basis of about the average shipment which could be gotten into a car in our grandfather's time. The car capacity has changed, but the minimum for the carload rate and the commercial unit has not moved up.

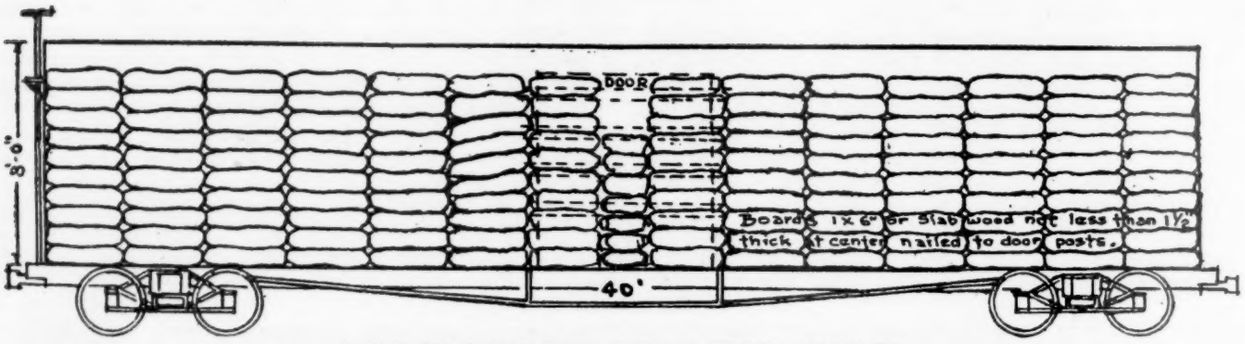
It is easy to say that the railroads ought at once to change their tariffs to provide for higher minimums and that the Interstate Commerce Commission ought to be ready and glad to allow such changes. But if such changes were made, it is almost a certainty that the Interstate Commerce Commission would be deluged with bitter complaints from many shippers. The argument would be raised that business customs, relations between wholesaler and jobber and jobber and retailer, and between retailer and customer, have been established on the basis of the present minimums, and that a disturbance of this relation at present would cause a serious disturbance to business. What is being done and can be done to offset the effect of the low minimums?

Shippers can be educated to load more than one unit in a car. Where this has been tried there have generally been, at the outset, some protests. In some instances loading two units into one car may cost a little more. This being so, the railroad must appeal to the patriotism and self-interest of the shipper to do his bit, even at the cost of additional outlay and trouble to himself. Persuasion failing, a railroad can bring pressure to bear on a shipper. Embargoes might be placed against cars not loaded to a certain percentage of their capacity, and there are many other means of exerting this pressure.

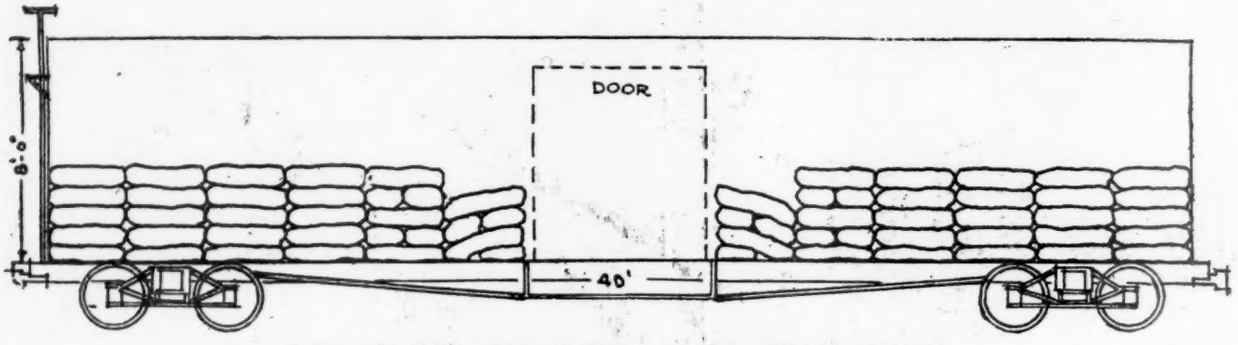
On the other hand, the shippers can retaliate by sending their shipment by a competitor's line. There was recently a very good illustration of this. Of a certain commodity, of which a large number of carloads are shipped out of New York every day, four roads were getting almost equal shares. One of them announced to the two or three shippers that it intended to accept only cars containing two of the commercial units. Most of the cars into which this commodity was being loaded could have comparatively easily been loaded with three commercial units. Hardly had the announcement been made before it was met with the threat that all of this particular business would be shipped over competitive lines. The road which had attempted the reform did not for the time being have the courage of its convictions and nothing more was done. After the Executive Committee of the Special Committee on National Defense of the American Railway Association had been formed in



(1) 37 Hampers in Car from South Carolina to New York; (2) This Shipment Should Have Been Put in One End of Car and the Other End Used for Another Shipment; (3) Not Enough Barrels in This Car to Prevent Falling; (4) Result of Loading Barrels of Potatoes on Their Sides.



A Full Load—1000 Bags of Sugar, Weight 102,000 Lb.



Commercial Selling Unit of Sugar—400 Bags, Weight 40,800 Lb.

Washington and the presidents of more than fifty of the largest roads had personally pledged their obedience to the letter and spirit of the suggestions made by the committee, from the shippers, and only a few days later another of the roads participating in these shipments made a similar announcement. This illustrates a case where co-operation,

The Methods Recommended by the Sugar Companies to Utilize All Available Space in Their Own Warehouses

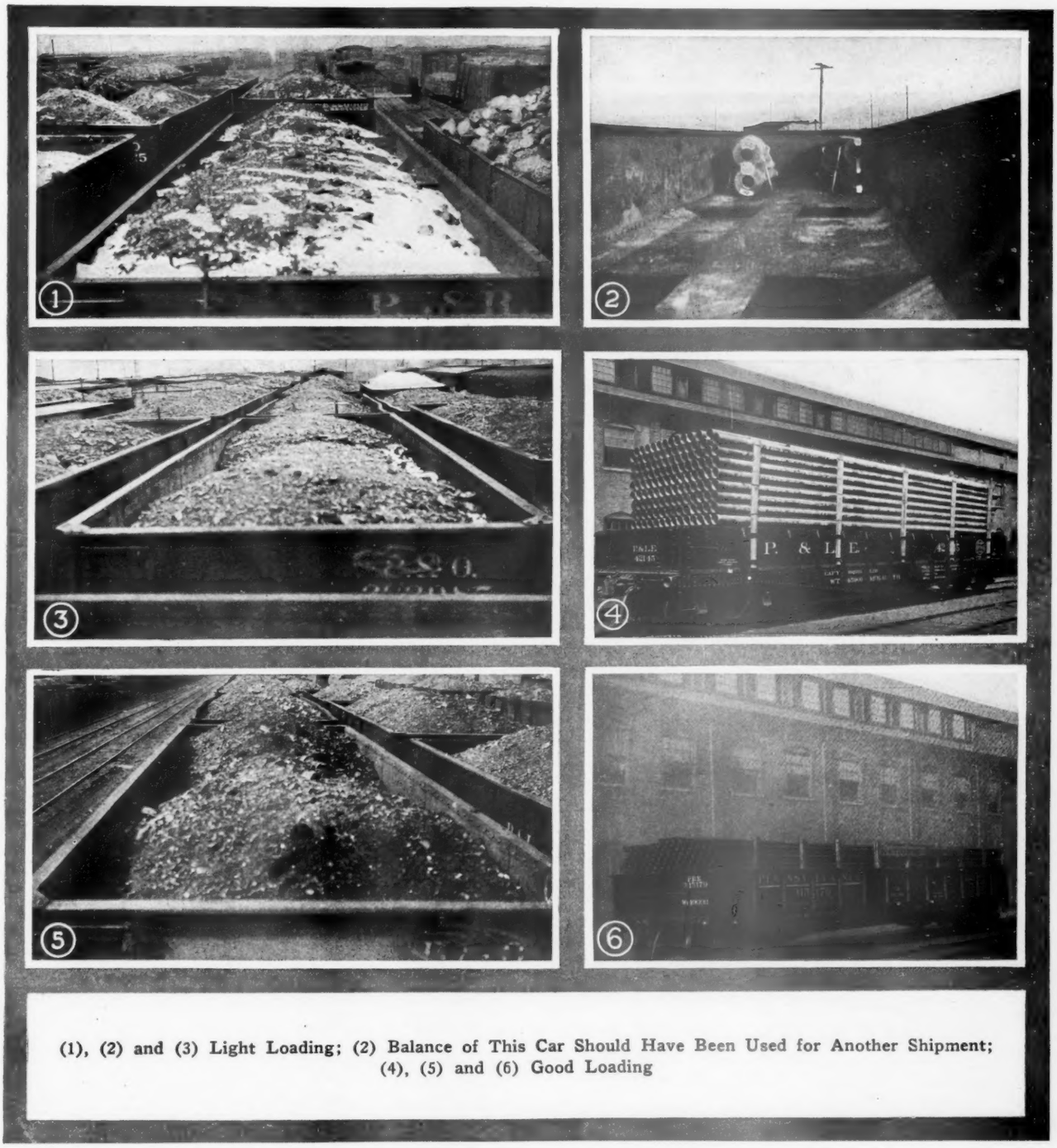
this road entering New York having acquired new backbone, again notified the shippers and proceeded to instruct its agents to carry out the proposal. There was no protest personal talks and friendly persuasion were not sufficient. Since the outbreak of the war, however, there have been numerous instances where persuasion and appeals for co-

operation have been sufficient to secure two-unit or even three-unit loading for commodities with low tonnage, commercial selling units.

The Most Important of All

Assuming that the preliminary work—the four principal branches of which have been described above—has been thoroughly done, how will it be possible to bring about a state of mind on the part of agents and shippers which will actually secure the results desired? How will it be possible to make each man place above his own selfish interest the desire to help the shippers, the railways and the nation? Is it impossible to bring about such a state of mind?

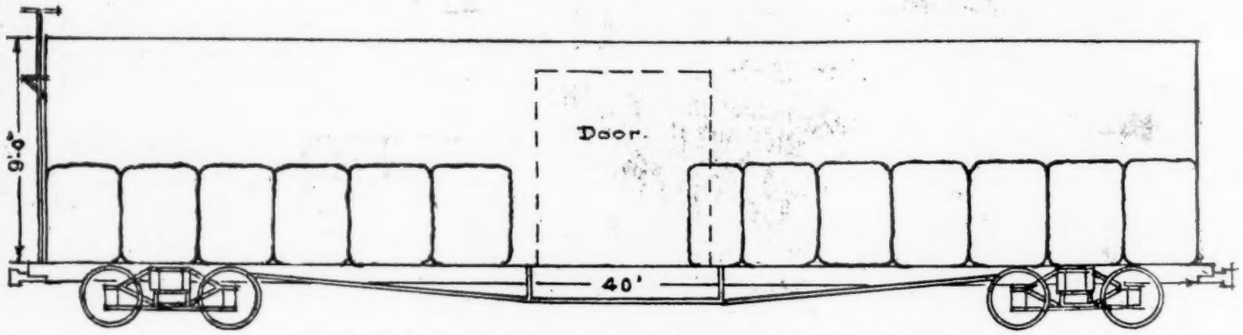
This last question, which demands attention first, can be answered by the simple and obvious fact that men do give up not only selfish interest, but life itself, for the welfare of their country in time of war. If this is so, it is surely possible to get men into a state of mind where they will make the comparatively small personal sacrifices involved in loading each car to the maximum practicable capacity for the good of the community as a whole, to the end that the present war may be won by the United States and her European Allies.



(1), (2) and (3) Light Loading; (2) Balance of This Car Should Have Been Used for Another Shipment; (4), (5) and (6) Good Loading

Such a state of mind, however, is not going to be brought about spontaneously. The greater part of the burden of developing this conscientiousness of responsibility and of opportunity for service will have to be borne by the railroads. There are, it is true, broadminded and patriotic shippers who are working diligently, with or even without

the co-operation of the railroad managements, to get other shippers to assist in utilizing freight cars to their full capacity. The subsidiary companies of the United States Steel Corporation are doing so; some of the lumber companies are doing so; some of the coal companies, especially some of those in the Hocking Valley field, are doing so. There are plenty of others; an honor roll of such shippers would probably be a long one. But even so, it is for the railroad companies themselves to undertake this vastly important campaign. There is no intention of implying that many of them are not already doing so. On the other hand, not the most partisan of railroad men would probably seriously maintain that the majority of railroads are doing all that they could do.

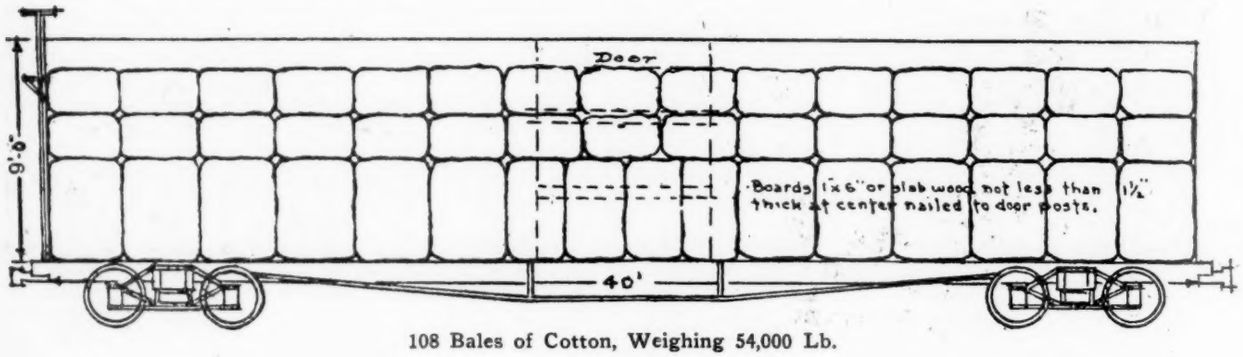


Trade Unit of Baled Cotton—50 Bales, Weighing 25,000 Lb.

One of the first steps that the railroads might well take would be to set their own house in order. There are even now a large number of railroads that are running l.c.l. package cars daily, or twice or thrice a week, regardless of whether they have a reasonable amount of freight for the cars. It had been the intention of the *Railway Age Gazette* to make a table showing the principal points from which package cars were being run, regardless of quantity, and the number of such cars weekly. So few full frank answers, however, were made to the request for information on this subject that the idea had to be abandoned. There are some roads—and not all of them among the largest, nor among those best situated to meet competition—which sent in very full lists of the points from which they are running package cars and the number of such cars they are running each week. But without having available similar reports from all of the competitors of these roads it would be unfair to publish any figures. Such lists as were sent in, however, showed that there are a great number of such cars being run, and even more significant is the silence on the part of other roads. A daily service which will haul an l.c.l. car 500 miles, with a few thousand pounds of freight in it, is a competitive practice which has no justification in the economics of transportation. It is discrimination, in that it gives certain classes of shippers for competitive reasons service for which they are not paying a rate fairly comparable with that paid for by other shippers.

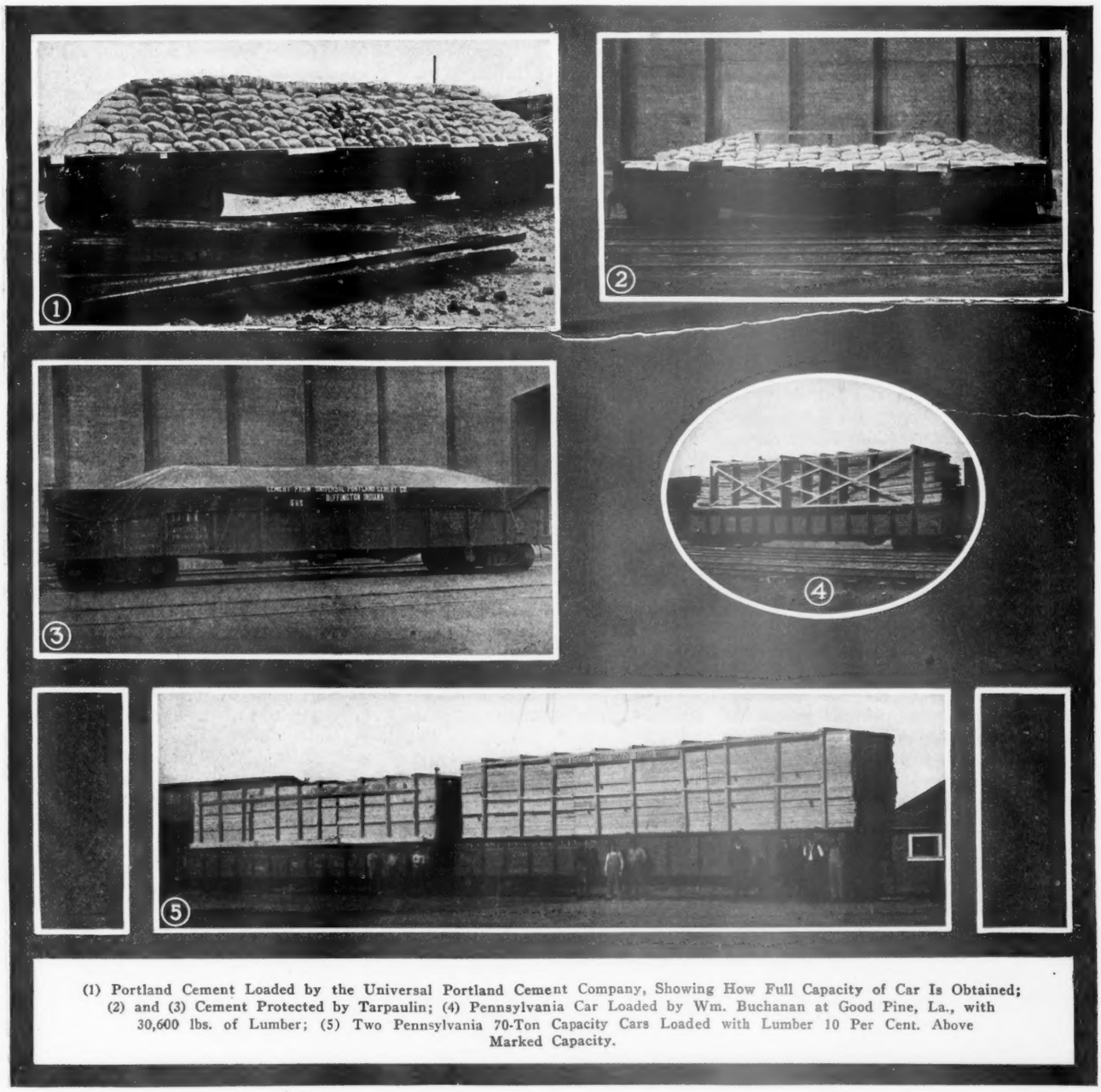
It is interesting and very encouraging, however, to find that some of the largest roads, both in the most keenly competitive trunk line and middle western territory and in the Northwest, have issued orders that no cars shall be run regardless of quantity, and have announced to shippers that where a sufficient loading for a car is not received on the day on which it is scheduled to run, it will be held until such time as a full loading is obtained. The definition of a reasonably full loading, of course, is elastic. Just how much the roads that have issued orders against running regardless-of-quantity cars are doing could only be judged from extended personal observation; but such orders are a step in the right direction and in the majority of cases it would appear that the principal thing needed by the railroads to cause them to cut out regardless-of-quantity cars, and get a reasonably heavy loading for each l.c.l. car moved, is a fuller understanding of the immense waste that is taking place, and probably a stiffening of their backbone by the committees in Washington.

Besides doing away with the wasteful competitive practice of running package cars, regardless of their loading, must come the work of educating and enthusing employees and agents of the railroads so as to get them to place good carloading ahead of a desire to please a particular shipper, or a more or less natural tendency to let well enough alone and not fight against the current. The ways of accomplishing this will be very different on different roads. Just as different executives do not use precisely the same methods in getting the loyalty and best work of their subordinates, so different managements will use different methods in bringing about a reform in the practice of their agents and employees. Some roads will probably issue orders and make it the duty of certain officers to see that these are obeyed; others will appeal to the intelligence and good will of agents and employees; but whatever the method adopted, if it is to be effective, it will mean supervision over this particular thing. It might well be that a road would find that it was necessary



108 Bales of Cotton, Weighing 54,000 Lb.

for the success of its better carloading campaign to be quite liberal in making appropriations for additional supervision. Already some roads have established special offices under various titles, the principal duties of which, however, are to give supervision to better carloading. In addition to personal talks with employees, circular orders and circular appeals, and checking up of results, there is another way in which the consciousness and conscience—sometimes the same thing—of employees can be reached; that is, through general publicity in the same way in which it is suggested in this article, that the interest of shippers and the general public can be stirred up.



(1) Portland Cement Loaded by the Universal Portland Cement Company, Showing How Full Capacity of Car Is Obtained; (2) and (3) Cement Protected by Tarpaulin; (4) Pennsylvania Car Loaded by Wm. Buchanan at Good Pine, La., with 30,600 lbs. of Lumber; (5) Two Pennsylvania 70-Ton Capacity Cars Loaded with Lumber 10 Per Cent. Above Marked Capacity.

Results Which Have Thus Far Been Obtained

The Canadian roads have been longer under the pressure of war necessities than have railways of the United States. Since the war began the average carload of revenue freight per loaded car on the Canadian Pacific has been brought up from 19.34 to 22.72 tons—18 per cent. From time to time various minimums have been advanced. A bulletin was published in March of this year of which 30,000 copies were distributed and a second bulletin has just been gotten out. Both bulletins are devoted to showing the difference which heavier carloading would make in the available car supply. In the second bulletin a sketch drawing of a typical 1915 train is shown with 23 cars loaded with an average of 18.45 tons. Below this is shown a train, which should be the average in 1917: 20 cars loaded with an average of 23.4 tons.

The best results which the Canadian Pacific obtained, however, were from a canvass of the shippers and a personal explanation to them as to just how heavier carloading helps everyone, including government, shipper and railroad. In 1915 an order was issued to the effect that only cars loaded to 10 per cent in excess of their marked capacity would be received at the lake front. It was figured that 13,000 car trips and the movement of 300,000,000 ton-miles of tare

weight was saved, including the empty mileage on back haul saved.

The Canadian Pacific found that company material was not being loaded as heavily as it could have been and it moreover found that it was about as difficult to get the railroad officers and employees to take extra trouble to get heavier carloading as it was to get the shippers to do so. For instance, the only way in which the company could get cars carrying ties loaded to their full capacity was to have the tie inspector refuse to bill any car unless it was thus loaded. This at first resulted in quite a bit of friction, but is now accomplishing the desired results. Largely through an appeal to their patriotism the Canadian Pacific was able to get a number of business concerns to change the commercial selling unit, with marked results in increased car-loading.

Many of the larger roads in the United States have sent out circulars or bulletins to shippers on their lines urging heavier carloading. A few typical instances only can be mentioned.

The Canadian Pacific has been mentioned first because Canada has been at war longer than has the United States; but as a matter of fact, there are roads in the United States which have been at this drive to get heavier carloading longer than have any of the Canadian roads. Notable among these is the Pennsylvania.

Make One Car Do the Work of Two

This slogan, "Make one car do the work of two," has been the watchword which the Pennsylvania has tried to drive home to every shipper, consignee, buyer, farmer's grange, manufacturers' association, board of trade and chamber of commerce in Pennsylvania territory. Pennsylvania car inspectors have gone out among shippers and consignees, and among the associations mentioned above, and with in most cases really remarkable patience have hammered away at this slogan in a manner that in the end is bound to get results and as a matter of fact is now getting very good results indeed. As proof of this, in the month of April, 1917, the average loading per loaded car on the Pennsylvania was 31.94 tons, an increase of almost three tons over the same month of the previous year. This represented a saving of 58,473 car trips and saved a movement of 189,689,000 ton-miles of tare weight, not counting the empty return movement which was counted in arriving at the Canadian Pacific's figure for saving in tare weight and which would add very much to the ton mileage saved by the Pennsylvania.

The Pennsylvania has gotten out a series of car utility bulletins, of which the fifth is illustrated with diagrams showing the waste in unloaded cars and showing also the amount of various commodities which could be gotten in the cars were they loaded to their full capacity. A number of these diagrams are reproduced in this article. The first car utility bulletin was issued on November 1, 1916. It was a single sheet signed by the general superintendent of transportation and the superintendent of stations and transfers. It was an appeal to shippers to co-operate with the railroads to "make one car do the work of two." Car utility bulletins 2, 3 and 4 were each a single sheet. Bulletin 2 was an appeal to "whenever possible increase the size of each individual shipment or commercial unit to a full carload" and examples were given of how shippers can help and how consignees can help. Bulletin No. 3 contained the reprint of an article from the Journal of Commerce (New York) headed "Car Shortage Due to Half Laden Cars." It was addressed particularly to the canners and urged raising the trading unit from the present 550 cases to 800 cases. Car utility bulletin No. 4 was a direct appeal to patriotism of shippers and consignees. It was headed "In War, Transportation Is an Essential National Arm." Bulletin 5, as has been mentioned, was illustrated and gave directions as to how certain commodities could be loaded more efficiently, and dealt particularly with the loading of non-perishable goods, or hard goods, as they are sometimes called. Another bulletin, No. 6, is now in the state of preparation and is illustrated with photographs and diagrams showing how perishable commodities are actually loaded and how they should be loaded. Accompanying this article are some of the photographs that were used in connection with the preparation of data on which to base this sixth bulletin. It is typical of the Pennsylvania that before urging shippers to load cars heavier with packages that might be damaged in transit, quite extensive experiments were made by the railroad company itself with each class of loading.

The Central of New Jersey sent out a circular calling attention to the notice issued by the Interstate Commerce Commission respecting car shortage, and ordered its agents to post these circulars in a conspicuous place and to direct the attention of shippers to them. Later 3,000 copies of a notice was sent to shippers, in which appeared the following paragraph: "Unless shippers will consider this situation seriously and by their fullest co-operation correct the evil, it will of necessity and in due course mean federal and state legislation, which may prove more burdensome than our appeal that cars be loaded to capacity." Following this an order was sent to the company's own agents as well as to shippers insisting on the adoption of the watch word, "Intensive Car Loading," and instructing agents to report to the general superintendent and the vice-president and the freight traffic manager the names of those shippers who were co-operating and rendering assistance, and also the names of those who were persistently or flagrantly violating the request for it.

The Chicago, Burlington & Quincy, insofar as the distribution of notices is concerned, has confined its efforts to giving the widest possible distribution to the circular issued by the Special Committee on National Defense of the American Railway Association, which circular will be mentioned later.

The Southern Railway is now preparing a circular which will be given very wide circulation.

The northwestern roads, including the Chicago, Milwaukee & St. Paul; Great Northern; Northern Pacific; Oregon-Washington Railroad & Navigation; Spokane, Portland & Seattle, and Spokane & Inland Empire, got out a joint circular in March addressed to shippers in Oregon, Washington, Idaho and Montana, explaining that these roads were unable to meet the present car situation without the assistance of the shippers. The three specific things which the railroads asked the shippers to do were, (1) in the purchase and sale of commodities to fix the weight according to the full capacity of cars ordinarily used for this commodity; (2) if available cars did not fit the original specification as to quantity, to authorize such increases as will permit the full loading of cars that are available; and (3) to write to representative officers of these roads calling attention to cases where full loading has not been obtained.

The Pittsburgh & Lake Erie in May issued a supplement to its loading order No. 6 in which it placed the minimum for l. c. l. freight at 25,000 lb., and also instructed agents to hold all cars of carload freight not loaded to the full carrying or cubic capacity of the car for instructions from the superintendent of freight transportation.

The International & Great Northern, under the receivers, has been making very extensive use of circulars, both to reach shippers and to instruct agents. In December, 1915, a two-page letter was written to all agents, signed by the general manager. This cited the results that had been obtained, the opportunities for still further improvement, and asked all agents to make the following New Year's resolution: "We hereby resolve to do everything in our power to increase the efficiency of our company and thus promote its ability to serve well its patrons."

The Delaware, Lackawanna & Western has issued numerous circulars, one of the latest being in April, 1917, in

which specific instructions as to how shippers and how consignees could facilitate the movement of traffic, obtain heavier carloading and release cars promptly.

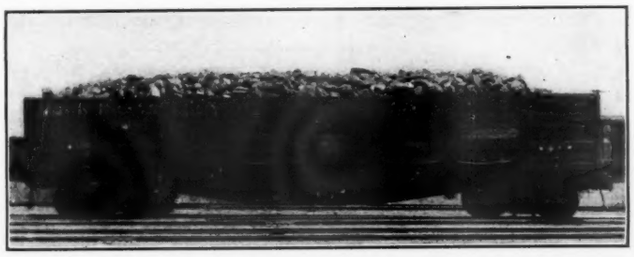
The Norfolk Southern has obtained good results from circulars which it has issued both to its own agents and to shippers and receivers. In one of these there appears the following: "Thus, if it is desired to order 100 tons of fertilizer, let the shippers be instructed to load in such a way as to utilize the full capacity of two 30 and one 40, or two 50-ton cars. Where a purchaser orders less than a full car it is suggested that he join with a neighbor so that the two shipments can be made in the same car."

The Chesapeake & Ohio in December, 1916, issued a cir-

A 40-Ton Car Carefully Loaded to Get 10 Per Cent Loading Above Marked Capacity

cular calling attention to the fact that while most of its coal cars were being well loaded, there were exceptions, and these were generally at mines where loading was not properly supervised by a mine superintendent or responsible employee. Better supervision was urged.

The New York, New Haven & Hartford in May issued a circular to shippers, consignees, agents and yardmasters quoting extensively from the circular issued by the Executive Committee of the Special Committee on National Defense of the American Railway Association. Later in the same month the company issued special l. c. l. loading instructions ordering the holding of l. c. l. cars for tri-weekly or semi-weekly



Ralston Type Car with Excess Cubical Capacity Loaded 10 Per Cent Over Marked Capacity

movement so as to get maximum loading, and ordering that l. c. l. freight aggregating 15,000 lb. that otherwise would go to a transfer point, should be loaded and carted to certain stations mentioned. The method of handling freight to and from boat lines has been changed. In order to secure following-morning delivery in New York it had been customary to send lightly loaded trains from Boston terminals early in the afternoon. Now, loading is permitted to 5 p. m. and cars are moved during the night and transferred to the boats on the following day, making second-morning delivery. Embargoes are also being issued against various commodities in carload lots, regardless of point of origin, except when loaded to marked capacity. Such commodities as brick, fertilizer, glass containers, lumber, ore, pig iron, etc., are included. An embargo has also been placed on l. c. l. freight coming from connecting carriers, except when loaded to a 15,000-lb. minimum.

In May, 1917, F. M. Lucore, assistant general manager of the Southern Pacific lines in Texas and Louisiana, got out a very interesting little booklet of 38 pages, with a cover, which was an "appeal for a substitution of the 'full carload lot' idea to take the place of the present 'minimum car lot' plan." The circular was addressed not only to shippers but to the railroad commissions of Texas and Louisiana; the bankers of Texas and Louisiana; the buyers of cement, lime and plaster; of cotton and cotton linters; of cotton seed, hay, ice, lumber, millstuff, rice, salt, sugar, wheat and other bulk grains. Each one of these classes to whom the pamphlet was addressed had a separate section.

Other roads besides those mentioned are carrying on special circularizing campaigns to increase carloading. The examples mentioned are simply used by way of illustration.

In addition to circularizing, the roads, with a few notable exceptions, are having their agents or officers personally interview shippers to try to induce them to get better carloading. Other methods which are being used are to have agents or yardmasters make reports of cars that are not loaded to capa-

All-Steel Car with Cubical Capacity So Small as to Require Very Careful Loading to Secure 10 Per Cent Loading Above Marked Capacity

city, with the names of the shippers, and these instances are called to the attention of shippers by correspondence and the matter is regularly dealt with through a series of follow-up letters. There are some roads that have issued instructions for their enginemen not to switch coal cars that are not loaded to full capacity. Within the last few months there have been quite a few roads that have created the position of car inspector or an office with duties similar to that of car inspector, and have placed on this office the responsibility and given it the authority carefully to watch carloading and take such

Contrast the Loading of This Car with the Loading of the Other Three Cars Shown on This Page

steps as are considered necessary to procure better results. One road at least, and possibly others, have written letters to the newspapers explaining the car situation and urging the public and urging shippers to co-operate to get better loading. Some roads have adopted a system of monthly reports showing both the names of shippers that

have gotten especially good carloading and shippers that are failing, for any cause, to load cars to capacity. Letters of appreciation are sent to shippers who have done especially well, and letters urging improvement are sent to those whose showing is bad. Some roads have given agents both authority and responsibility for better carloading at their stations. A report is kept not of shippers who have poor carloading but of the stations from which underloaded cars are received. The agents at such stations are asked for explanations and the responsibility is placed squarely on them.

Some roads do not hesitate to write directly to shippers who load on connecting roads. Others deal with the connecting carrier in urging better carloading. There is a difference of opinion as to which of these methods is at once the more effective and the more diplomatic.

Some roads have found it a big help to discuss at division staff meetings this question of heavier carloading. Nearly all roads appear to be convinced that personal efforts of agents and division officers can accomplish a great deal in securing the co-operation of shippers, and a good many roads frankly acknowledge that if they could only get their own officers thoroughly imbued with the right spirit it would not be so difficult to get shippers to do their part. Staff meeting discussion is a good way of arousing enthusiasm among the railroad company's own officers.

A few roads have had merchandise loading reports sent to the chief operating officer showing in detail carloading by commodities and by loading points. The Missouri, Kansas & Texas by this method alone got an increase in April, 1917, over April, 1916, of 3,508 lb. per car.

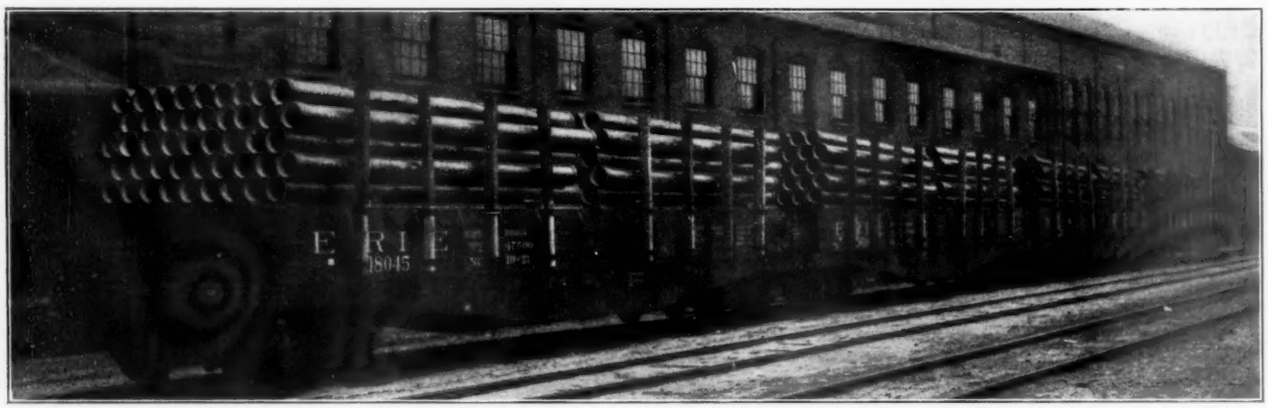
It is an interesting and very illuminating fact that the roads which have done the most toward securing better carloading and which have gotten the best results are the very roads that feel most strongly that they have only begun the work, and that the savings of equipment which are still possible through additional efforts are larger than they had any conception of when the work was begun.

Beside the work that the roads have been doing, that of various shippers and other organizations has been of great assistance. The American Railway Association has issued various bulletins which have been published in the *Railway Age Gazette* from time to time; the various branches of the Standard Oil Company are sending out cards and other literature urging heavier carloading; from the South comes a report of 98 shippers of carload business from Tennessee, Kentucky, Florida, North Carolina, South Carolina, Georgia and Missouri, that have each one of them made special efforts to conserve railroad equipment; the Pittsburgh Coal Company and the Coal Dock Operators' Association are refusing to accept orders for coal in less quantity than maximum capacity of car furnished; the National Tube Company, a subsidiary of the United States Steel Corporation, is making special efforts and there is printed herewith pictures of some of the cars loaded by this company.

A number of pictures of loading by the Universal Portland Cement Company are given. This company has been making a remarkably good record. From May 1 to May 9, inclusive, all cars loaded from its Chicago plant were loaded to 108.6837 per cent of marked capacity. There were shipped during that period 1,384 cars; the total marked capacity was 99,725,000 lb. and the total amount of material loaded was 108,384,820 lb. This is notwithstanding the fact that there were loaded a large number of stock cars and flat cars, the carrying capacity of which would not permit of the full 10 per cent overload above marked capacity.

From the Pittsburgh plant of the Universal Portland Cement Company from April 23 to April 30 all cars were loaded 105.5 per cent of marked capacity, and from May 1 to May 10, 108.3 per cent of marked capacity, and from May 10 to May 19, 109.99 per cent. The average shipments from the Pittsburgh plant are 60 to 70 cars a day.

The following is an abstract from a bulletin issued by the general sales manager of the Portland Cement Company.



Four Cars Loaded with 10-in. Wrought Iron Pipe by the National Tube Company—Average Weight, 120,500 lb.

"The burden, however, does not rest solely on railway managers and operatives. Shippers and consignees have a duty to perform. There are between 250,000 and 300,000 points at which freight is handled in this country. A slight quickening in the time of loading and unloading at each of these points will make a tremendous saving. The average time consumed by shipper and consignee in loading and unloading a freight car is a little under two days each, a total of four days per car trip. This period can be reduced by one-third or more. The men who can bring this about are those who load and unload freight cars. It is substantial.

"War has put a heavy burden upon the railroads. With the backing of every shipper and of every receiver of freight their work will be effective. It is unthinkable that this co-operation will not be forthcoming. It would mean that industry would flounder in a sea of inaction. But business must not suffer. Our allies must get what is essential for the strong prosecution of the war. Our army must mobilize and equip. New ships must be built. The means to this end are partly in the hands of shippers and receivers of freight."

In conclusion it may be said that railroad traffic departments must back up and co-operate with the operating departments. Courage on the part of the traffic departments will be required in a large measure. It is spirit which is put into this work that will count. The encouraging fact is that the more fully the situation is understood by every one the more likelihood there is of its being overcome.

Modern Method of Storing Coal

The Fuel Situation as Affected by the War

Serious Problem Caused by the Difficulty in Securing Supplies and on Account of the Greatly Increased Cost

IN 1915 the railways of the United States used 128,000,000 tons of coal, or 24 per cent of the total output of the mines of this country. Of this amount 122,000,000 tons was bituminous, which amounted to 28 per cent of the bituminous coal mined, and 6,200,000 tons was anthracite, this being 7 per cent of the total anthracite production. In 1916 the total shipments of bituminous coal amounted to 509,000,000 tons, an increase of 15.1 per cent over 1915, when previous records had been surpassed. It is probable that the railroads used about the same proportion of the total coal supply in 1916 as in 1915, in which case the consumption of coal by the railways in the past year was approximately 148,000,000 tons. There is every reason to believe that 1917 will see new records established in the production in all kinds of fuel. The iron and steel industries are large users of coal and they will consume a greater amount than ever before. The amount exported also will be increased by larger shipments to France and Italy.

The Fuel Situation

RAILROAD fuel consumption will probably increase during the war and owing to the unusual demand and abnormal conditions of distribution prices will continue high.

The fuel department should give close attention to the selection, distribution and handling of coal and arrange storage facilities.

The mechanical department should apply fuel saving devices, keep motive power in efficient condition and see that coal is properly used by the enginemen.

The operating department can assist by running fewer and heavier trains, by eliminating delays and by securing heavier loading of cars.

Fuel Shortage on European Railways

Experience in the European countries indicates that energetic measures will be required to deal with the fuel problem in this country during the war. The most serious effect of the hostilities on the railways of the neutral country of Switzerland is the scarcity of coal, which had reached such an acute stage in February that the number of trains on the steam railways, already diminished, was further reduced by 20 per cent. Before the war the Swiss railways secured their fuel from Belgium and Germany. The demand for coal in Germany is now so great that even the consumption of hot water for household purposes has been limited. This, together with the shortage of men and of rolling stock, explains why Germany has not fulfilled her agreement to furnish Switzerland the fuel which that country requires.

The Norwegian railways, which have drawn their supply of coal from England, are also facing a serious situation. The general director of the Norwegian state railways stated recently that no coal had been received since January 1, and that the quantity stored would last only four months. Traffic on all the railroads has therefore been limited.

The fuel situation in Great Britain is so serious that no coal is allowed to be exported. The supply for France and Italy has hitherto come from England, but the United States will now be called upon to furnish fuel for both these countries.

Coal Consumption of American Railways

The bill of the railways of the United States for fuel for conducting transportation in 1915 was $216,838,183, of which probably about $17,000,000 was spent for fuel oil and the remaining $200,000,000 for coal, both anthracite and bituminous. From present indications the railroads will use more coal during 1917 than ever before, and this must be purchased at prices greatly in excess of those paid during any previous year. The rail-

roads' total fuel bill for 1917 will no doubt be between $300,000,000 and $350,000,000.

The relative amount of fuel oil consumed by the roads will probably neither increase nor decrease to any marked degree during the war. The United States Navy will require a large amount of oil, and it is certain that the price will remain high. From present indications but little of the oil for the navy will be furnished by the fields from which the railroads are supplied, and they should find no difficulty in securing the amount they need.

Between the years 1911 and 1915 there was a steady decrease in the proportion of operating expenses chargeable to fuel, the percentage declining from 12.05 in 1911 to 10.38 in 1915. This decrease was made in spite of slight increases in the unit prices during that period. There has undoubtedly been an increase in the proportion of operating expenses chargeable to fuel during the past year, but this increase has been brought about by the advance in the unit cost and not by the increased consumption. The increase in the cost of coal for the present year on the Pennsylvania system alone, based on the consumption in 1915, is estimated at $15,099,000.

Reasons for the Advances in Price

There are many factors entering into the advance in the price during the past few months, one of the most important being the shifting of markets. The Illinois and Indiana fields, for instance, have been obliged to meet exceptional demands. The production of coal in the West Virginia fields was decreased by floods. There was a good market at the seaboard for coal from this section, and as a result the coal from West Virginia, Western Pennsylvania and Eastern Ohio did not move to the Great Lakes and the region of the lower Ohio in the usual quantities. The shortage around the Great Lakes was aggravated by the lack of cars, and the fact that lake boats handling grain and ore eastward did not stop to load coal for the western trip, but returned with water ballast to secure the more profitable cargoes of grain and ore. Low water on the Ohio river also threw an added burden on the railroads, as it prevented coal moving down the river in barges. The Illinois and Indiana fields have therefore been forced to supply coal for a much larger territory than usual.

Such shifting of markets has caused the railroads not only to haul more coal, but to haul it longer distances as well. For instance, it has been stated that the commercial coal sent to Michigan from the Illinois and Indiana fields was over 17 times as great during the nine months from April to December, 1916, as it was during the entire year preceding.

To overcome the difficulty which has been experienced in securing coal in the Great Lakes region, it is planned to load grain and ore vessels with coal and thus relieve the railroads of the extra burden which was placed upon them during the past season. River transportation depends largely upon the precipitation, and it is impossible to forecast the conditions during the coming season. The securing of an ample supply of coal depends to a considerable extent on the restoration of the methods of distribution that are followed under normal conditions.

Another factor in the increased cost of coal has been the advances in wages granted to the miners. Due to this cause alone the price has advanced in many cases as much as 50 cents a ton. The fact that consumers having contracts with mines often were unable to secure the amount they desired, has led to frantic bidding for "spot" coal, or that part of the output not covered by contract, and the prices paid have advanced beyond reason. The report of the Federal Trade Commission stated that in some cases cars held under reconsignment and demurrage privileges appeared to have been used as temporary storage to further speculative activities. Where such conditions are found to exist vigorous measures should be taken to prevent the abuse of the rules governing the use of cars.

Shortage of Coal Most Acute in New England

The shortage of coal has been most acute in New England, in Detroit and in the northwestern section of the country. The coal consumed in New England amounts to 20,000,000 tons a year. Under normal conditions part of it is shipped by rail to Poughkeepsie, Albany and Troy and part is carried by boat from Newport News, Norfolk and Baltimore. Since the demand for vessels and the rates on ocean freight have increased so markedly, many ships have been diverted from the coastwise carrying traffic. So great is the demand for barges that the rates on coal from Hampton Roads to New England have increased from 60 cents to $5.25 per ton. The railroads have been badly congested at Poughkeepsie and at Albany, and it has been practically impossible to secure an adequate supply of fuel in New England. The New Haven has been obliged to buy coal in the open market at prices ranging from $7.35 to $8 a ton.

Here, again, the restoration of normal methods of distribution would assist in relieving the shortage of fuel, and it has been suggested that the tugs and barges necessary to transport the coal be exempted from military use. The situation in Detroit is almost entirely a matter of congestion of terminals, and the establishment of storage facilities is probably the only solution of the difficulty.

The Northwest has relied largely on getting a supply of coal from the Pittsburgh district. This year the supply at the head of the lakes was almost entirely consumed before the opening of navigation, although usually there has been carried over about 3,000,000 tons. Many lake boats have been diverted to the more profitable ocean traffic, and if an adequate supply of fuel for the Northwest is to be secured this year it is absolutely necessary that lake vessels carry the maximum possible amount of fuel. The pooling of coal shipments at the lakes will no doubt have a good effect in expediting the traffic.

An unnecessary burden is imposed on the railroads in certain cities by ordinances requiring anthracite coal to be used by them. The seriousness of the fuel situation at this time warrants a discontinuance of such measures in some sections. If local officials could be made to realize the difficulties under which the railroads are working, their co-operation in suspending the use of anthracite could no doubt be secured.

Grades of Fuel Should Be Carefully Considered

In meeting the present emergency it is especially important that the grade of fuel which shows the greatest economy, all things considered, be used. The selection of the proper grade and size is a difficult matter, as the usual test for heat content is not necessarily a measure of the efficiency of the fuel when burned in the locomotive firebox. The experiments recently completed at the University of Illinois, in which six sizes of coal from a single mine were tested to determine their relative values, give a better indication of the results which may be expected in actual service.

The coals were tested at a medium and at a high rate of combustion (about 50 and 110 lb. of coal per square foot of grate per hour, respectively). The comparative values for the various grades were as follows:

Grade.	Medium Rate Tests.	High Rate Tests.
3 in by 6 in. Egg	102 per cent	105 per cent
Mine run	100 per cent	100 per cent
2 in. Lump	99 per cent	97 per cent
2 in. by 3 in. Nut	98 per cent	106 per cent
2 in. Screenings	93 per cent	87 per cent
1¼ in. Screenings	85 per cent	82 per cent

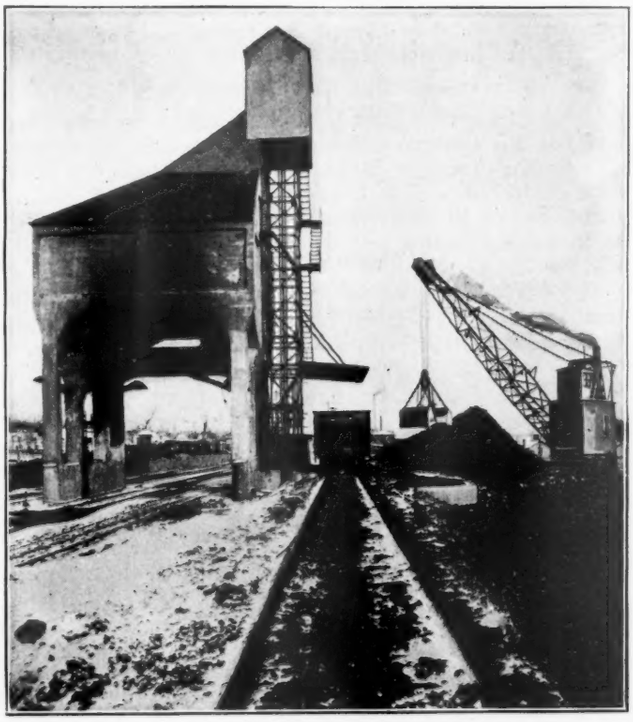
From these results it would seem that with the usual price differentials mine run would be more economical than lump or egg coal. The comparative value of 2-in. and 1¼-in. screenings differs so much that unless there is a large price

differential between the two grades the larger size is to be preferred.

The Preparation of Coal

Regarding the preparation of coal, the report of these tests contains the following observations: "Cracking coal to the point where it will pass through a 5-in. round or a 6-in. round opening is worth more than it costs. Under many conditions mechanical crushing of the larger sizes of coal will be found very profitable. Many roads prepare elaborate statements showing the cost of operating coaling stations, and often as a result of these statements coal is not properly cracked; e. g., a coal needing much cracking will be sent to a coal chute having breaker bars, and as a result the cost of chute operation goes up. The fuel distributor is then told to send this to a chute where there are no breaker bars, and the result is that the coal is only slightly cracked."

It should be borne in mind that the lower the heating value of the coal the more cars are required to transport it. Thus, when coal must be carried for a long distance it is



Revolving Locomotive Crane Serving Storage Yard and Coal Chute

usually cheaper to secure a supply with a high heating value. On one railroad coal from several mines located in two different fields were tested in road service. The tonnage which would be required of each kind was calculated for all the engine districts on the system, and the cost of fuel, freight and handling was computed. Among the coals tested was one with a heat content of about 11,000 B.t.u. per lb., which could be obtained at a low price, and was in use over a large part of the system. The officers of the road were surprised when the test proved that a much more expensive coal with a heat content of about 13,500 B.t.u. per lb. was more economical at some points where it required a longer haul than the lower priced fuel. The weight of the better grade of coal required was considerably less, and for that reason the lower freight charges offset the slightly higher cost on the B.t.u. basis.

Increasing the production of mines which yield high grade fuel is one method of saving cars. The same effect is secured by carefully removing impurities from the coal. There should be no laxity in the inspection of fuel at this time.

If the handling of coal is to be done satisfactorily, storing during the summer months must be resorted to. Some of the western roads which are called on to handle a large amount of commercial coal during the winter months have for several years followed the practice of storing company fuel during the summer season at every point where a chute is located. The coal can be secured at a lower price at that time, and there is ordinarily no difficulty in obtaining cars in which to move it. The storage piles are located close to roundhouse tracks as a rule, and when the fuel is needed it is picked up by a locomotive crane and loaded directly on to the tender. An arrangement of storage facilities at coal chutes, such as is illustrated herewith, should prove convenient and economical.

Coal should be stored in dry locations. The larger sizes are to be preferred and slack should be screened out if possible. Coals which have a high sulphur content are most likely to heat and ignite spontaneously. As a rule, the temperature is not allowed to rise about 180 deg. F. By driving flues to within two or three feet of the bottom of the piles the temperature of the coal can be noted, and if it is found to be heating the pile is worked over. The loss in heating value of Illinois coal stored one year is only 3 per cent, and coal from other sections which does not disintegrate when exposed to the weather should give as good results. The danger of spontaneous combustion is slight. Illinois coal is stored to a depth of 15 ft. without trouble, and Pittsburgh coal has been stored in piles 30 ft. high.

Cars must be unloaded promptly in order to conserve the car supply and insure an adequate supply of fuel, and storage facilities are a necessity.

Modern Coaling Stations Conserve Fuel

Of equal importance is the installation of modern coaling stations to save men and to conserve fuel. Coal should be broken to the proper size for locomotive use before being put in the chutes and further reduction in size should be avoided. Chutes as now designed cause little breakage, and they reduce greatly the cost of handling. At the present price of labor, chutes in which coal must be shoveled from the cars by hand show operating costs as high as 12 cents a ton. The modern chute in which drop bottom cars may be used will handle coal at a cost not to exceed 3 cents a ton. Whatever form of chute is in use, it should be so arranged that it will not cause waste by spilling on the ground.

The fuel consumption of locomotives must be kept at the lowest possible figure. Where fuel saving devices can be installed much can be done to improve the performance. The savings made possible by superheaters and brick arches are so well known that it is scarcely necessary to mention them. Practically all railroads are installing these devices on existing motive power as well as specifying them for use on new equipment. The president of one road which had applied superheaters in considerable numbers recently said: "We have put on 40 superheaters now, and they are paying for themselves at the rate of one each week."

Although powdered coal has been introduced but recently, it gives promise of effecting large savings, and its use should be developed as rapidly as possible. Feed water heaters have shown excellent results in tests, and the mechanical difficulties which the maintenance of such devices might entail would seem to be slight compared with the benefits to be derived from their use. The railroads should investigate the opportunities for reducing their fuel bill by the application of such devices.

To secure a good fuel record every locomotive from the oldest to the newest should be maintained in the best of condition. When the motive power is given a general overhauling all parts which by their condition affect the fuel

consumption, such as the boiler, boiler tubes, steam pipes, front end appliances, smokebox, valve and cylinder packing and valve gear, should be put in condition to perform at their highest efficiency and the roundhouse men should see that they are properly maintained while the locomotives are in service. Anything which wastes steam wastes coal, and every one who has to do with the repairing of locomotives should bear this in mind.

The men in charge of roundhouses can help to save fuel by seeing that boilers are kept clean both inside and out so that the heat from the fuel may be transmitted readily to the water.

There is also a splendid opportunity to reduce the amount of coal used at the terminals in firing engines and in keeping them under steam. In maintaining locomotives special attention should be paid to keeping steam pipes and superheater units tight, superheater flues clean and brick arches intact. Leaks around the mud ring and air leaks in the front end are wasteful and should be stopped as soon as they appear.

What Labor Can Do

The officers of the enginemen's labor organizations have lately voiced the loyalty of the men to the nation's cause. Every engineer and firemen can show his patriotism at this time by doing his utmost to save fuel. Firemen are often inclined to fire locomotives not in the best way, but in what they consider the easiest way. If the traveling engineers would teach every fireman to break large lumps of coal, to prevent coal being wasted out of the gangway, to use no more water than is necessary in wetting coal, to carry a light even fire, and to add two or three scoopfuls of coal at a time, a marked improvement in the fuel consumption would be secured. Every road foreman of engines should pay particular attention to the correction of improper firing methods, and to the elimination of defects in locomotives which cause a waste of fuel. The attention which is usually given to the lubricating oil performance should at this time be directed toward the saving of coal.

The car department can save fuel by reducing the weight of cars whenever it can be done without sacrificing strength and increasing the cost of maintenance. If cars were provided which could be used for hauling a large variety of commodities so that they would be loaded in both directions, the empty haul would be lessened and the fuel consumption would be materially reduced.

The part which the operating department can play in saving fuel as a rule has not received much attention. Lightly loaded trains and trains standing on side tracks are both wasteful. Yardmasters and despatchers must cooperate to keep engines loaded to their full rating and to see that they are not delayed at meeting points. The records of train operation on one railroad showed recently that the delays to trains between terminals amounted to 48 per cent of the running time. The amount of coal burned by a large modern locomotive when held on a side track is estimated at from 500 to 1,000 lb. an hour. Even if the lower figure is used, the fuel wasted in this way amounts to a large item.

Many delays at meeting points are caused by slow trains getting in the way of faster trains. If the speed of all trains was made more nearly uniform, much of the trouble from this source would be eliminated, thus bringing about an appreciable saving in fuel.

Running Locomotives Over Two Divisions

A number of railroads have adopted the policy of running locomotives over two divisions, and the savings resulting from this practice have been gratifying. There are no doubt many more places where the plan could be put into effect and it merits consideration at this time. The average cost of fuel for firing up a locomotive is at least one dollar, and this is saved, in addition to the amount usually wasted while it is kept under steam waiting for a train, every time the locomotive is run over two divisions.

Trains run on extra fast schedules use an abnormally large amount of fuel. The resistance of passenger trains running at a speed of 60 miles an hour is 30 per cent greater than when the speed is 40 miles an hour, and the coal consumption is correspondingly higher. If passenger trains are consolidated and fewer and heavier trains run, there will be a double saving, first, on account of the smaller number of cars which will be required; and, second, because of the decreased consumption per car with the more heavily loaded trains. The same thing applies to fast freight trains. In Canada much has already been done along this line. The Canadian Pacific now has but one scheduled time freight train, and the schedule of this train has been lengthened 10 per cent.

An active movement to secure heavier car loading is now on foot, and numerous statistics showing the savings in cars, locomotives, tracks and men have been prepared. The saving in fuel has not been shown, but it is by no means neglible. If the average load of freight cars is increased five tons per car it will result in a saving of 14 per cent of the fuel used in freight train service.

Fuel for Other Than Locomotive Use

Up to this time but little has been said concerning shop fuel, but it is an item of considerable importance since about 20 per cent of the total fuel bill of the railroads is spent for fuel for other than locomotive use. Stationary boilers should receive as good attention and be maintained as well as locomotive boilers, and the methods of firing should be watched just as carefully.

Where planing mills are operated the sawdust and chips from the woodworking machinery can be utilized for fuel. Scrap lumber from cars can some times be burned under boilers after being sawed to suitable sizes, or where this method is not applicable it can be reduced to chips and blown into furnaces. In cases where intermittent heats are taken on oil furnaces fuel can be saved by using furnaces of the regenerative type. Centralized power supply for shops, the installation of electric motors, and electric power transmission are necessary if the highest efficiency in the use of fuel is to be secured.

For the improvement of the coal situation the following measures, among others, are necessary:

Restore the normal condition of distribution as far as possible.

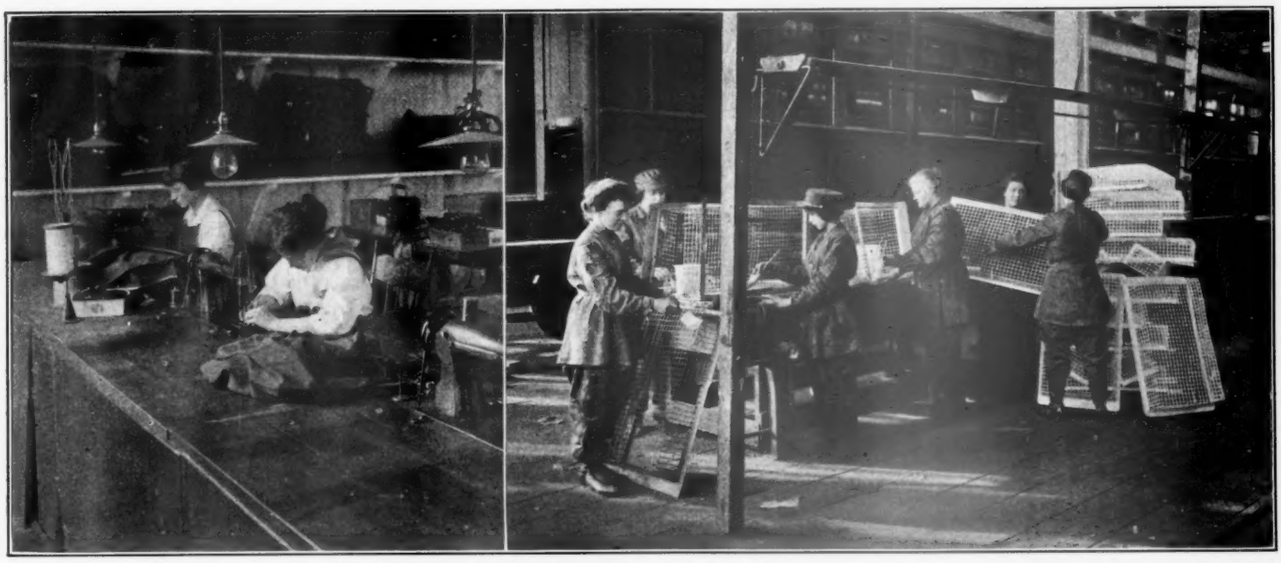
Provide storage facilities to lighten the burden on the railroads at the time of maximum demands.

Stop the abuse of the reconsignment and demurrage privileges.

Effect such changes in railroad operation as will result in a lower consumption of fuel.

In the handling of and use of fuel, employ every measure possible to secure economy.

During the past decade noteworthy improvements have been made in the effective utilization of fuel. There are at present numerous promising experiments under way, and it is not unreasonable to assume that methods of effecting even greater savings will be evolved. Urgent as the need for men may be, this is not the time to discontinue researches which have for their aim the development of better methods of using fuel. It is essential that all known means of saving be put into effect, and that new methods be developed if possible to supplement those already in use. The utilization of lignite would help to remove the difficulties which are hampering the railroads, and if the problem could be solved at this time it would do away with a heavy transportation burden, and enable the railroads more effectively to care for the unprecedented traffic which they will be called upon to carry during the war.



Making Sleeping Car Curtains *Painting Racks in Passenger Car Department*

The Railroads of Canada and the War

Have Successfully Handled Greatly Increased Traffic In Spite of the Great Scarcity of Labor and Material

ONE cannot but marvel at the part the Canadian railways have played in the war program and the deep seated spirit of loyalty that actuates them, and yet it is only in keeping with the spirit of the country at large—a country of between seven and eight millions population that has enthusiastically gone to the support of Great Britain with an army of more than 400,000 men. The casualties have been extremely heavy; in presenting the compulsory military service bill in the Canadian House of Commons, Sir Robert Borden stated on June 11 that they numbered 99,000. Many will never return; others have already returned maimed and crippled for life. The hospitals of the land north of us are filled to overflowing.

Canada realizes fully not only the vital part that the transportation machine plays in the successful carrying on of the war, but the seriousness of the situation, and the tightening of the jaw or the break in the voice of railway men as they speak of friends and relatives in the trenches is a surface indication of the determined spirit which lies behind the present operation of the Canadian railways. So far as improved methods of operation and maintenance are concerned, there is little that is new; the splendid results that are being obtained under abnormal traffic conditions are due rather to a more intensive application and development of practices that were in effect on most progressive roads before the war. The new element is the really remarkable spirit that dominates the roads. The Canadian railways will doubtless have still greater obstacles to overcome than those which have confronted them since the war began, but no shortage of men or materials will be allowed to interfere with their effectiveness so far as it relates to the operations at the front.

A Wonderful Spirit

CANADIAN railways ready to sacrifice everything for their country and the cause it is fighting for.

Thousands of employes have gone to the front in the fighting forces and in the Railway Construction Battalions and Skilled Workers Sections.

The railroads have sent equipment abroad, contributed generously to patriotic funds and have helped make munitions.

Large numbers of troops successfully handled.

Women are being used extensively to overcome labor shortage.

Various means have been taken to facilitate operations under abnormal traffic conditions and to conserve material and equipment.

In commenting on the spirit of loyalty which actuates the railway officers and employees in handling troops and supplies, Brigadier General Biggar, director general of supplies and transport, stated that even the section men feel a strong sense of individual responsibility in guarding against delay or accident to the trains. A motive power officer summed up the situation thus: "We are ready to give to the very limit—everything if necessary—in the interests of our country and the cause for which it is fighting."

The Canadian boys in the trenches express this sentiment in a different way by the following version of "Keep the Home Fires Burning":

Keep the Huns retiring,
Keep the guns on firing,
Keep our air ships flying
Until the Boches are done.

Keep the bayonets flashing,
Keep the boys on dashing;
And when we have turned the Germans inside out
Then we'll all come home.

Conditions at Beginning of War

At the beginning of the war the Canadian railways were suffering from over-expansion and also because of a general business depression due to crop failure. Some of the roads had retrenched to the very limit and were "down to the bone." The government railways were in fairly good condition as to maintenance because Parliament had authorized the management to make heavy expenditures for this purpose in order to keep the men busy and thus contribute to the prosperity of the territory served.

The management of the Canadian Pacific also felt that it was its duty, as one of the most important business institutions of Canada, to do what it could to keep business going, and it therefore maintained its normal forces and did a large amount of maintenance work which might have been deferred.

In the fall of 1914 business was at a low ebb and all of the roads had more or less power lying idle and whiteleaded. By November, however, business had picked up because of the war, and most of the equipment was in service. Since that time traffic has increased to a point where it has pushed the roads to the very limit of their resources, particularly in view of the shortage of labor and the difficulty in getting new equipment, or even of material for ordinary maintenance and renewal work.

The past winter was especially severe and prolonged and the roads experienced great difficulty because of the lack of the necessary number of skilled workmen to keep the equipment in good running condition. Canadian experiences should be a warning to the United States. The world depends upon us for foodstuffs and supplies and measures must be taken to prevent too many skilled workers or laborers leaving the roads either to go into service abroad or into other industries.

What Canadian Railways Have Done

Not only have the Canadian railways enthusiastically done those things that are required of them in the ordinary business of carrying on transportation, but they have gone much farther in giving of men and money and have also placed their facilities at the disposal of the government for the manufacture of supplies and munitions or for other purposes.

Employees of the Canadian Pacific to the number of 6,692 had enlisted for over-seas service up to May of this year. Of these, 293 had been killed and 611 wounded. The Canadian Pacific "Roll of Honor," dated June 15, states that the honor lists to that date show 404 killed and 905 wounded.

A. W. Smithers, chairman of the board of the Grand Trunk System, in his address at the annual meeting, April 26, 1917, stated that "since the beginning of the war 3,342 Grand Trunk employees have enlisted, of whom 178 have been killed and 300 wounded." The other Canadian roads have been equally hard hit in sending men to the front. At one shop, for instance, 50 per cent of the men enlisted. In one locomotive firemen's lodge 42 of the 160 members have gone to the front. Another locomotive repair shop has lost 25 per cent of its employees through enlistments.

Railway Construction Corps

That many of the employees have enlisted in the different branches of the forces engaged in actual fighting may be judged by the heavy casualties noted above. Others have enlisted in the Railway Construction Corps and the skilled workers sections. While the work in these sections is possibly not as hazardous as fighting on the actual front the men are frequently compelled to carry on their work under fire.

The duties of the Railway Construction Corps include the building and repairing of railway lines, docks, shipping facilities and roads in the war zone. When the history of the war is written one of the most notable developments as compared with previous wars will undoubtedly be the fact that the railway lines have been pushed to the very front and have swiftly followed the advances in order to keep the troops fully supplied. Thus far Canada has sent seven railway construction battalions overseas, a total of 5,313 men; this includes three special drafts, as noted in the following table:

Canadian Railway Construction Battalions

Unit.	Place Recruited.	Date of Sailing.	Commanding Officer.	Strength. Officers.	Other Ranks.
Can. O. S. R. C., Corps	St. John	6-14-15	Lt. Col. C. V. P. Ramsey	20	503
143rd Battalion	Victoria	2-17-17	Lt. Col. A. Powley	32	883
218th Battalion	Edmonton	2-17-17	Lt. Col. J. K. Correll, M. P.	24	582
228th Battalion	Toronto	2-17-17	Lt. Col. A. Earchman	31	756
239th Battalion	Windsor	12-20-16	Lt. Col. J. W. Stewart	26	738
256th Battalion	Toronto	3-28-17	Lt. Col. W. McConnell	17	531
257th Battalion	Ottawa	2-17-17	Lt. Col. L. T. Martin	29	902
Railway Construction Draft	Winnipeg	3- 4-17		1	34
Railway Construction Draft	New Westminster	3- 4-17		1	35
Railway Construction Draft	Regina	3- 4-17		3	166
			Total	183	5,130
			Grand total	5,313 all ranks	

Col. C. V. P. Ramsey, in charge of the first Railway Construction battalion to go to France, was formerly engineer of construction of the Canadian Pacific. At the request of the government that system prepared two 65-ton steam shovels and two self-propelling extension track pile drivers for shipment to the corps after it had gone abroad.

Roland Hill, writing from the Canadian Army Corps' headquarters in Flanders to the Toronto Star early this year, made the following reference to the work which is being done by these railway construction battalions:

"The specialization in the Canadian army strikes you immediately. Many other units that were looked upon as frills have proved more than useful over-seas. In the Railway Construction Corps each man is a specialist in something. It is such a useful organization that the Imperial authorities have borrowed it. I found them building railways. Bridge military engineering rules are strong and unbreakable, but the Canadian engineers have mastered them and here they are building a standard gage line within the shell zone in Flanders with Canadian rails and ties, even Canadian steel work, to replace bridges. While I was chatting with the colonel a request came in for two divers. They were wanted at the base. There were five in the battalion and they had no trouble in getting two."

The Railway Construction Corps includes men from the bridge and building department, section men, railway construction men, general construction men and laborers.

Two Railway Skilled Workers' Sections have also been sent abroad. Each one of these includes three officers and 266 other ranks, the officer in charge being a railway mechanical

officer with operating experience. The men in the ranks are proportioned to the various crafts skilled in the maintenance of equipment and its operation. Capt. A. H. Kendall, formerly master mechanic of the Canadian Pacific at Toronto, has charge of the first section which was sent abroad. Capt. R. McKilloe, in charge of the second section, was formerly superintendent of the Laurentian division of the Quebec district of the Canadian Pacific. Both of these sections were sent to France this spring and are forerunners of the railway mechanical regiment which it is expected shortly to be sent from the United States.

Canadian Railway Equipment at the Front

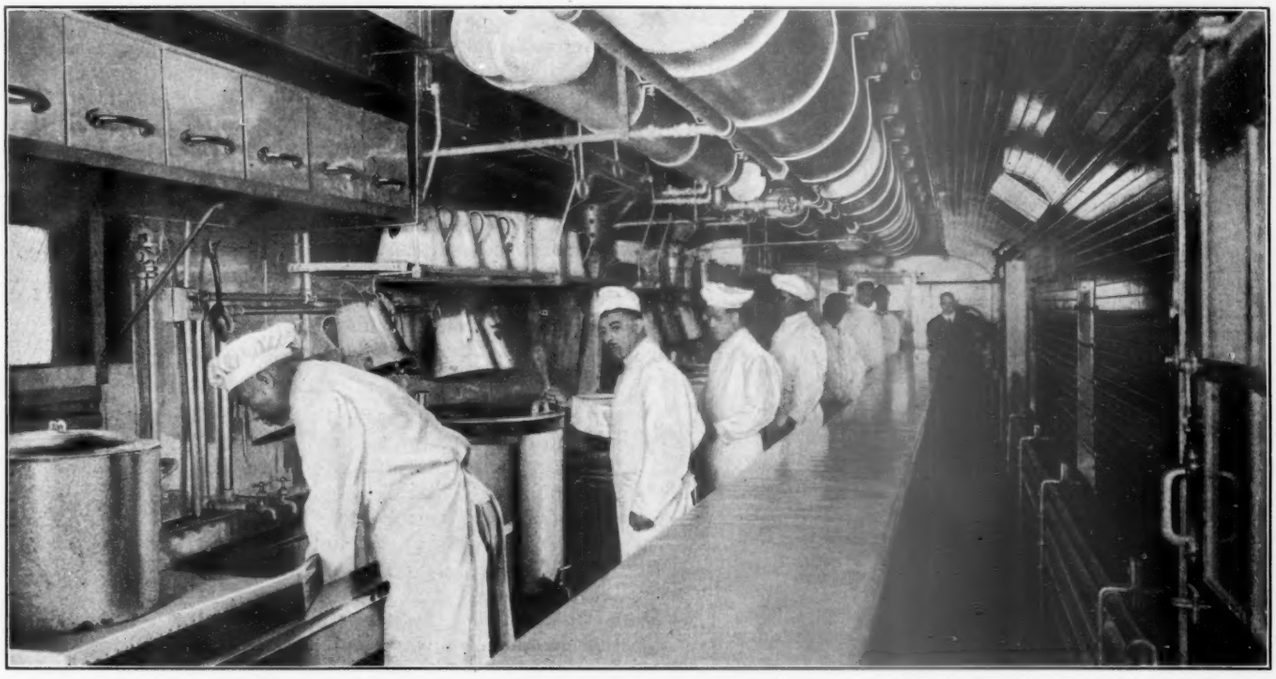
Because of the inadequacy of the transportation facilities in France the British government requested Canada to do what it could to supply rails and other track material suggesting that, if necessary, track which was already in service be taken up and shipped abroad. In December of last year a Dominion order in council was passed authorizing the National Transcontinental Railway to ship abroad 300 miles of rails, with the necessary turnouts, angle bars, bolts, spikes and other track material. A still greater amount of this material is required in France and will be supplied by taking up about 300 miles of track west of Edmonton, where the Canadian Northern parallels the Grand Trunk Pacific. The Grand Trunk Pacific uses the same standards as the Transcontinental, from which the first shipment was made, and the authorities feel that all of this equipment should be taken from the Grand Trunk Pacific and should be replaced by Canadian Northern equipment in such places as it is desirable to maintain the Grand Trunk Pacific line rather than that of the Canadian Northern.

Manufacturing Munitions

When war broke out the railway repair shops were not busy and the government called upon them to assist in the work of making munitions. The equipment of these shops was, of course, not especially suited for this work and it was necessary for the railroads to construct certain special machines and practically to develop separate departments for handling this work. As the war progressed, industrial companies were organized to do such work and were especially equipped throughout for handling it. Meanwhile the railway shop facilities were required for making repairs to railway equipment and gradually the amount of munitions work assigned to the roads has grown less and less until only a comparatively small amount of it is being done by them now. It is greatly to the credit of the railways that they came so promptly to the aid of the government and did such good work with tools and facilities at their disposal until the special manufacturing interests were in position to take over all of this work.

Payments to Enlisted Employees

The Canadian railways at the beginning of the war made special arrangements for the payment of wages or salaries to enlisted employees for certain specified periods. In spite of the fact that the roads are greatly handicapped by losing so many skilled workers, most of them still continue to do this, although not to the same extent as formerly.



Interior of Grand Trunk Kitchen Car

Up to November, 1915, the government railways arranged to pay full salaries in addition to the military wages. Since that time employees who have gone to the front have received the difference between their former salaries and the compensation paid to them by the government. These payments will continue indefinitely.

On the Grand Trunk employees joining the colors were kept on the pay roll at full pay for a period of six months, with the understanding that their positions would be open to them upon return from active service. In April, 1915, the company announced that it would continue to carry its men fighting over-seas on the pay roll for a further period of three months at half pay, following the expiration of the six months at full pay. This system of direct contribution to employees enlisting was changed in March, 1916, and the company since that time has donated $10,000 a month to the Canadian Patriotic Fund for the maintenance of the soldiers' dependents.

The Canadian Pacific at the beginning of the war announced that it would continue to carry enlisted employees on the pay roll at full pay for six months after they had set sail and half pay for six months thereafter. This was later modified and full pay is now given for the first six

months of military service. It is understood that the men will be taken back into service on the same basis as before enlistment, whenever they are relieved from their military duties.

Those roads which have provided funds pay the same amount to the relatives of an enlisted employee who is killed as if he had remained in company service.

Patriotic Fund

As above noted, the Grand Trunk contributes monthly to the Patriotic Fund of Canada, which is used to supply comfort and relief to soldiers' families. Other Canadian roads have made large contributions to this fund and the railway employees have been extremely liberal in giving to it individually, in some cases contributing regularly each month. In the campaign for this fund in Montreal the publicity was organized by J. M. Gibbon, publicity manager of the Canadian Pacific; within five days over four million dollars was raised at an actual net outlay of one-tenth of one per cent. This fund has the reputation of being the most economically administered of any large charitable enterprise in Canada, the cost of its administration amounting to less than the interest on the bank balances.

Handling Troops and Supplies

The Canadian railways have successfully done their part in transporting to the seaboard the 400,000 soldiers who have gone over-seas. That the task has been no easy one is indicated by the fact that a large proportion of these soldiers had to travel over long distances and that in addition to supplying them with comfortable accommodations the railroads also had to contract to feed them en route. More than this, if for any reason it was not possible to transfer the men direct from the cars to the ships, the railroads were required to furnish them with quarters and meals until the transfer could be made. As many as 35,000 soldiers have been handled in one month, most of them being transported in colonist or third class cars, each of which provided sleeping accommodations for 52 men. The officers were furnished with Pullman sleepers. In the limited number of cases where it was necessary to resort to day coaches, one full seat was allowed to each man. The men take their blankets and rifles with them on these cars, but leave their kit bags in the baggage car.

In almost all cases the military authorities were able to advise the roads at least a week in advance of the time the troops were to be moved, thus making it possible to mobilize the necessary equipment without too much disturbance to the general operation of the roads. The Canadian roads are better fixed for handling troops than are the American roads because of the large number of colonist cars which it has been necessary for them to provide for their normal business.

The difficulties in handling the troops were complicated until the United States entered the war, because of the fact that the main line of the Canadian Northern runs through part of northern Minnesota, while the Canadian Pacific runs through part of the state of Maine. This made it necessary to route all troops and supplies in such a way that they would not pass beyond the borders of Canada. The National Transcontinental, for instance, had to handle all the troops going to Halifax. As a 13-car train would only handle five or six hundred men it was not at all unusual to move a large number of troop trains each day over this single track line from Montreal to Halifax; other traffic, of course, had to take second place when such movements were being made.

The Canadian Northern made a really remarkable record in providing transportation to the concentration camp at Valcartier during the early months of the war. It was decided at that time that Quebec was the best port for embarkation, and the concentration camp was located at Valcartier, about 19 miles distant. Within two weeks provision was made for taking care of 35,000 men, although the Canadian Northern had only a single track from Quebec to Valcartier, and it was necessary to build 20 miles of sidings at the latter place as well as an immense loop practically surrounding the camp. After a month's practice tents were rolled up, the camp cleared and the trains transported the 35,000 men to the ships at Quebec. This intensive experience at the very outset was probably the means of emphasizing to the Canadian railways the extent and importance of the work which lay before them, and the success which accompanied the initial movement was doubtless an inspiration in overcoming the harder problems in the months which followed. As difficult as the task of handling the men was, that of promptly forwarding the equipment and supplies which they required over-seas, was even more so.

In arranging for the shipment of material to the British government the traffic departments of the railways have had to keep in intimate touch with the director of over-seas transport, who looks after all such shipments passing through the Canadian ports and also has more or less supervision over French shipments. The government has requisitioned the greater part of the space on all ships and it is necessary that a sufficient tonnage of the class of freight required be kept moving to the ports. It is extremely desirable, and indeed necessary, that not only should the tonnage capacity of the boats be filled but the cubic capacity as well, and this requires a careful selection of the various commodities and often demands the switching out of cars which contain commodities that are given the preference.

Feeding Soldiers En Route

The dining car departments of the different roads took charge of feeding the soldiers en route. On the Canadian Northern a kitchen car was provided which was placed near the center of the train, with restaurant cars at either end; the men entered the car under the direction of an officer and were given a specified amount of time in which to eat their meal in order that others might take their places without too much delay.

On the Grand Trunk, restaurant cars were provided, the interior of one of which is illustrated. These cars are furnished with one or two large hotel ranges, steam cooking apparatus, and a large amount of refrigerating space and storeroom capacity. To feed a battalion en route from Camp Borden, Ont., to Halifax the following staples must be provided: Two tons of fresh meat and bacon; 1,200 lb. of beans, 1,500 loaves of bread, 50 bags of potatoes, 1,400 lb. of sugar, 400 lb. of coffee, 100 lb. of tea, 300 gals. of milk, 500 lb. of butter and 600 lb. of oatmeal. Eight cooks can work in the kitchen car without confusion. When the time comes for serving the meal the various portions are spread on the counter. A sufficient amount of hot foods can thus be provided, so that details from the various cars on the train can come into the car and carry back the rations for each group of men. It is thus possible to serve everyone on the train within a short time; it may be done in 15 minutes.

It is not unusual, when a heavy shipment of troops is being made, to draw so heavily on the dining car forces that the regular service is more or less crippled. For instance, on the Transcontinental it was sometimes necessary to cut the dining cars off the regular trains and make meal stops at stations. In such cases the train conductors carefully explained the situation to the travelers, and it is worthy of comment that in practically all cases the inconvenience was taken in good part when its cause was understood.

Hospital Cars

A description of the hospital cars, which have been provided upon the Canadian railways and the manner in

which they are used will be found in the article on "Ambulance Trains from the Civil War" on another page.

Overcoming the Labor Shortage

As indicated in an earlier portion of this article, the loss of skilled workers and laborers by enlistment, and also to manufacturing industries which were able to pay much higher wages, has greatly handicapped the Canadian railways. The situation has also been aggravated by the fact that the railroads in their patriotic zeal have been exceedingly liberal in their financial arrangements with those who have enlisted.

The railways which have provided provident funds and normally pay good wages are able to compete fairly well with industries under ordinary conditions, but can hardly compete successfully in large industrial centers with the high rates that are paid by munitions works, which were willing to go to almost any extreme in order to get men. To relieve this situation it has been possible in some cases to transfer men from office to outside work and replace them with women employees or others who are not fitted for the more active work. There seems, however, to have been no special effort made to provide special instruction for rapidly breaking in and increasing the efficiency of new employees. Ordinarily this situation seems to be handled by the busy foreman or supervising officer, or by placing the green hand with a skilled worker. Such remarkable results have been obtained on roads that have made extensive use of special instructions and shop demonstrators for such purposes that it is surprising that this practice was not more generally followed.

A census has been taken by the National Service Commission with a view to making the best use of the experience and abilities of the men of Canada. Among other questions which were asked were those as to the exact experience which each man had, and also whether he would be willing to go to another part of Canada if he could be used to better advantage at some other place than that at which he was located. The National Service Commission on the basis of these replies transferred five or six hundred men to railway service who had had experience in that field but were not engaged in railway work.

It is quite possible that some of the soldiers who have been wounded and returned to Canada may be able in time to fit themselves for classes of railway work which they may be capable of performing and for which the railways will undoubtedly be glad to use them. The possibilities in this direction, however, are not very great so far as relieving the present labor situation is concerned.

The Use of Women

There are many classes of work on railroads that have been done by men that can readily be done by women and for which they have a special aptitude. They have, for instance, been introduced extensively into railway offices, replacing men who have enlisted or have taken outside positions in the operating and other departments. It is of interest to note, however, that a number of the women employees have left the service to go to the front as nurses.

Women have been used in the past in large numbers in manufacturing industries and it is not surprising to find that the shortage of labor has made it necessary to use them in the larger railway shops of Canada. The surprise is that they are used not only on the lighter work in the machine shop but for many classes of the heavier and rougher work throughout such plants as the Angus shops of the Canadian Pacific and the St. Charles shops of the Grand Trunk at Montreal. The working conditions in these shops are better than in the average railroad repair shop. In the Angus shops, for instance, a large amount of new equipment is built each year in addition to the repair work.

There are several other reasons which are responsible for the satisfactory service that the women are giving in these shops. In the first place, they are paid on the same basis as men engaged in similar tasks. Comfortable retiring rooms have been provided in convenient locations and these are in charge of capable women, who not only look after the comfort of the women but act more or less in the capacity of matrons. Last, but not least, it is thoroughly understood that any man charged with conduct unbecoming a gentleman toward the women employees will be immediately discharged.

At the Grand Trunk shops the first step in the introduction of women employees was the provision of facilities for the convenience of the women. They were then introduced in groups of six, thus providing a certain amount of companionship and making it easier for them to feel at home in the new surroundings.

At the Angus shops the women were recruited and assigned to the various classes of work under the direction of Mrs. J. W. Bell, the wife of the superintendent of the Windsor street station building. A thorough investigation was made of the circumstances of each woman before she was employed and close supervision was exercised over the women while they were being broken in on the work. They were assigned to tasks for which they seemed to be best adapted and are promoted or transferred as they show exceptional talent or ability. Several young women who started

Operating M. C. B. Billing Machine; Canadian Pacific

Stripping Steam Heat Hose; Canadian Pacific

in at coach washing have since become office assistants.

To a great extent only those women that are in special need have been given work. Many of them are widows, soldiers' wives, or women who are the sole support of dependents. That the working conditions are generally satisfactory and agreeable is indicated by the fact that at no time has there been any scarcity of applications for work at the Angus shops.

In addition to clean and comfortable retiring rooms, convenient to each department, and each in charge of an attendant, a large dining hall has been provided near the center of the plant where the women may gather in a body to eat their lunches. The room is furnished in white and the long tables are covered with white oilcloth. Facilities are provided so that the women can prepare hot tea or coffee. Hot soup and bread are furnished at cost by the company. Alongside the dining room is a free library with a plentiful supply of books, and also a lounging room, which is carpeted. The central dining hall not only adds to the comfort of the women employees but makes it possible to exercise closer supervision over them during the noon hour. A first aid room is provided in this building with a suitable equipment. A number of women have been trained in giving first aid, so that there is no necessity for the men attending injured women.

Experiments have resulted in the adoption of a special uniform for the women, which is shown in the photographs. This is more comfortable and convenient for shop work than the conventional dress and is far more safe, particularly where it is necessary to work near machinery or in the erection of cars. That the women appreciate this uniform is indicated by the forceful petitions from those who have not yet been so provided because of the difficulty at this time of securing material.

Those who have charge of the women workers suggest that there are a few things that it is necessary to keep in mind in handling them. In introducing them into the shops it is perhaps well to go to the extreme in insisting on discipline and proper deportment. It must also be recognized that women naturally tend to divide into small groups or cliques of two or three and do not mix generally as do the men. They also place a greater importance on their jobs than do the men and are therefore on the average more faithful and remain longer on the job. On the other hand, if it is necessary to discharge them they take it much harder and the foreman may be embarrassed by tears and beseechings.

A rough idea of the classes of work which the women are doing at the Angus shops and the extent to which they are used may be of interest. They are employed in the locomotive repair shop to only a slight extent. On the main floor of the machine and erecting shops they were found handing out tools from the central tool room. Several of them operate milling machines, brass lathes and do other light work in the manufacturing tool room in the machine shop balcony. Several women are also employed in the electrical repair shop making repairs to armatures, field coils, etc.

Between 40 and 50 per cent of the inside employees in the storekeeping department are women. They were found doing such work as sorting small castings on trucks, in the unloading of material from cars, packing the material for shipment, checking shipments, and doing clerical work, sweeping and trucking of material.

As might be expected, comparatively few women are employed in the foundry, practically all of them in this department being engaged in core making.

Apparently work in the car department is more suitable for women employees than that in the locomotive repair department, for at least 200 are engaged in the various tasks of repairing passenger equipment and building new freight cars. It is the practice on the Canadian Pacific to do practically all of the passenger car overhauling during the winter months when the demand for passenger cars is lightest. During the summer months a large part of the force in the passenger car department is transferred to the freight car shops and is used in the building of new equipment.

In the passenger car department women are used for scrubbing the passenger cars as they come into the shop for repairs; baking enamel on the car trimmings; working on the inside trim; cleaning and varnishing the cane seats; painting and varnishing sash blinds, racks and similar parts; interior painting; making mattresses and sleeping car curtains; sewing carpet; making sheets and pillow cases, etc. Two women are also regularly employed in cleaning and repairing triple valves. Each of these valves is carefully tested before it leaves the shop, and the women have given excellent service.

Eight new refrigerator cars are now being built each day in the freight car shop. The trucks are erected in the truck shop and the wooden underframes are assembled and placed on the trucks outside of the freight building shop and underneath the traveling cranes. The work is so divided that at intervals of an hour the cars in the various processes of construction on the two building tracks in the shop are pulled forward one car length and the gangs which have finished their special work on the cars which have been moved forward, begin all over again on the new ones which have taken their places. This means that the work must be carefully laid out so that no gang will hold the others back. As women are used for certain classes of this building work it means that they must keep strictly up to schedule; the other employees will see to this, for the work is done on a contract basis and the gangs will not tolerate delay or indolence on the part of any one gang.

When the underframe on the trucks is pulled into the building shop a gang of three women immediately starts to place the insulation between the sills. This requires about an hour. When the car is moved forward a gang of men nail on the flooring, and at another advance the framing is erected. Here we find women nailing on the thin inside insulation. On the next advance gangs of women are used for putting on the roofing insulation, which, of course, necessitates their working on top of the car. In completing the car women are used for applying the Leflare door packing and also for doing the inside puttying and varnishing. In all 60 women are used in the building of the eight cars that are turned out each day.

Thus far women have only been used for the cleaning up work on the freight car repair tracks at Angus. A small but neat rest room is provided in the yard for lunching purposes and for the lockers.

In the steel shop, where the steel underframes and framing are assembled for freight and passenger cars, women are used for operating drill presses and similar work. One young lady, not very large but quite energetic, was noticed operating a three-spindle bolt threader.

Women are used in the truck shop for operating drill presses, cleaning and sweeping. One woman was engaged in operating three-power hack saws.

Forty-one women were found at work on the scrap docks and in the reclamation plant. Twenty-five were working outdoors unloading cars of scrap and sorting it. These women were more muscular than those doing the inside work and handled the heavy parts and pushed wheelbarrows with the same energy as do men ordinarily engaged in this class of work. They have not yet been provided with the special suits which, of course, would be far more satisfactory than skirts for work of this kind. Although they were observed on a cloudy day, with frequent showers, none of them had knocked off and gone home.

Of those working inside the reclamation buildings one was engaged in operating a paper press, another in cutting up scrap hose, one in sorting out small scrap, including nuts, washers, etc.; one operating a nut tapping machine, and others running bolt cutters and sweeping and cleaning. In the munitions plant women are used for gaging as well as cleaning the shells.

About 75 women of a total of 2,000 employees at the Grand Trunk shops were found doing about the same classes of work as at Angus. One noticeable feature at the Grand Trunk shop was a woman policeman or watchman, who, while she was keeping watch at the main entrance of the shop, was also engaged in sweeping up around the machines and keeping things tidy. In the car shop women are working as piecework checkers.

One of the illustrations shows a number of women sacking grain in an elevator on the Great Lakes. They are also employed in various other capacities over the Canadian Pacific on such work as cleaning coaches, positions in the telegraph service, and in a great variety of positions which hitherto have been filled by men. In not a few instances they are acting as station agents.

In general, however, it may be said that as yet few women are used outside of the offices on the Canadian railways as compared with the roads in England and France, where women are used for almost every conceivable purpose.

Varnishing Cane Seats; Canadian Pacific

Sacking Grain at Elevator; Canadian Pacific

Conservation of Equipment

One of the war measures for the conservation of material on the Canadian Pacific was the making of a thorough and careful inventory of all of the material on the system from coast to coast. When this had been completed the heads of the various departments held conferences and measures were taken to utilize all of the material possible and to dispose of all useless material.

Closely allied to this measure has been the tendency on the part of all of the Canadian railroads to extend their facilities for the reclamation of scrap and waste material. Indeed, the material situation has become so serious that some of the railroad officers are frank in expressing the opinion that this effort has been the means of saving the day for the Canadian railroads.

The fuel situation has been exceedingly serious, and far more so than on American roads, which are nearer the source of supply. The British government has taken over practically all of the output of the mines in Nova Scotia and recently there has been a strike of coal miners in the west. This, of course, will not help the situation next winter as the supply on hand is only a small percentage of what it usually is at this time of the year and the indications do not seem favorable for getting as large a supply from the United States as is desirable.

A couple of boilers in the power plant at the Angus shops have been fitted for burning wood, and scrap wood is being gathered up within a reasonable distance and shipped to the power plant for such use.

Improvements in car loading are noted in another article. In general it may be said that the most striking results have been secured by holding back shipments of l.c.l. until the cars were loaded more nearly to capacity and loading such commodities as permitted to the very limit of capacity of the cars, even going beyond the 10 per cent excess in many cases. The Canadian Freight Association has recently taken action to insure the concerted action of all the roads in the effort to secure better car loading results.

In the interests of better train loading speeds of freight trains have in many cases been reduced. This has also, of course, resulted in a better utilization of the fuel. There has also been a very considerable reduction in the number of passenger trains, the Canadian Pacific making a reduction of 60, the Grand Trunk 61, the Canadian Northern 29, and the National Transcontinental saving about 20,000 passenger train miles per month.

A movement has been made on the part of at least one of the Canadian roads to cut down the size of the portions served on dining cars, thus eliminating useless waste of food. Moreover, the Canadian Pacific is not now allowing the use on its dining cars or steamships of veal, lamb or baby pigs, young chickens, and their products. It is hoped that this will help to discourage the practice of using these for food purposes.

Shop practices in so far as possible have been improved with a view to increasing the productive capacity of the individual worker, and the regular programs of improvement work in the interests of better maintenance of cars and locomotives have been intensified. Indeed, this may be said to be true of all efforts in all of the departments on the various Canadian railways.

A few of the labor-saving methods noticed in Canadian shops are as follows: The use of electric trucks for transferring material in the shops, and even of gasoline trucks for transferring material from one shop to another; also the use of platforms on which the material could be piled and so arranged that the body of a truck could be run under them and elevated so that the loaded platform could readily be transported to its destination and lowered to the ground, thus releasing the truck for other purposes.

High speed steel has been conserved by welding small

pieces on soft steel shanks. This has made it possible to so conserve the supply on hand that some of the shops will not have to go into the market for such steel for several years.

Autogenous and electrical welding apparatus is being used generally for new and repair work and for the reclamation of material. Brass work on cars and locomotives is being replaced as far as possible by iron and steel castings

What the Canadian railroads have done during the war in the maintenance and engineering departments is referred to in other articles in this number.

The Canadian railroads have urged and encouraged their employees to use portions of the right of way for gardens, and have assisted farming communities in their efforts to increase production.

After the War

The Canadian Pacific is prepared through its department of natural resources to provide 1,000 farms at an expenditure of about $3,500,000 for the use of returned soldiers. The roads generally will take back employees into the service when they return, giving them back their old, or similar positions, or using them for such work as they may be best fitted after their wartime experiences.

As suggested at the beginning of this article the remarkable way in which the Canadian railways have handled the greatly increased traffic due to war conditions, in spite of the loss of many skilled men and a shortage of material and equipment, is due not so much to any new type organization or methods that have been introduced, as to the intense spirit of patriotism and determination to win, with which the railway organizations are thoroughly imbued. The railways of the United States will have little to fear if their officers and employees can be filled with something of this same spirit.

RAILWAY EMPLOYEES IN WAR TIME

The following article, which appeared in a recent issue of the Baltimore & Ohio Railroad Employees' Magazine, was written by Major Charles Hine, then special representative of President Daniel Willard. Major Hine is a West Point graduate; he left the army to enter railroading; he served in the Spanish war as a major of volunteers; after that war he went back into railroading and he recently has been appointed commander of field trains of the New York division of the National Guard with the rank of colonel. In view of his unusual career, which has been partly military and partly railway, a message from him to railway employees is of special interest:

Again the employees of the Baltimore & Ohio Railroad welcome the opportunity to serve the cause of liberty. As in 1846, in 1861, and in 1898 the United States Army and Navy, including the Marine Corps, the National Guard, and the newly created additional forces, call for railway transportation to play its valuable part in mobilizing the forces, and in handling equipment, munitions and supplies. The technical military term for such part of the operations is "logistics." "Strategy" plans the war and determines upon its larger objectives. "Tactics," the handling of troops to carry out the strategy, include "drill" which trains the forces in discipline and the orderly execution of movements.

This time the railways are a relatively larger element of success in war than ever before. That every employee will do his or her bit and do it well is a foregone conclusion. Some, however, will do this bit better than others. The most helpful will be those who can the furthest forget all thought of self-comfort and ease. The few employees so foolish as to consider themselves martyrs and to growl because war conditions have changed their particular kind of work are, without realizing it, really unpatriotic, no matter how much they may shout for the flag and abuse the common enemy. The stern school of war conditions roots out selfishness to make room for true patriotism.

The Baltimore and Ohio Railroad has a personnel of officials and employees second to no similar body in the world. For the most part the working forces find themselves at familiar tasks in accustomed places. Not so with the military forces. Our little Army and Navy are being suddenly expanded and are necessarily filled with officers and men, a large percentage of whom are still green at their new jobs. In the shakedown of active service and in the merciless school of war they will measure their capabilities and become more efficient every day.

Suppose that the Baltimore and Ohio woke up some morning to find that its 4,500 miles had increased tenfold, or to 45,000 miles, over night; that it had to recruit officials and employees for this additional mileage at once; that green track laborers had to be promoted to section foremen; that shop apprentices became general foremen in a week; that a fireman bucking the extra board found himself running a passenger engine; that a brakeman a few weeks in service was signing orders as a conductor; that a student switchman became a yardmaster; that a green operator had to work as a train despatcher. Of course, out of the 60,000 employees and those from other roads, there would soon be found capable men for officials, sub-officials, foremen, conductors, engineers, etc., who in turn would educate the newer and younger employees. But could they be expected, right away, to do as good a job of railroading as the present highly trained personnel? The point of all this is that the Baltimore and Ohio will be expected to do relatively better work than the military forces it is so suddenly called upon to serve. Therefore, both officials and employees must cultivate patience and vigilance and then more patience and more vigilance. Some very foolish orders will be given by green military officers. Some annoying mistakes will be made in the routing and billing of freight and supplies. The officials and employees on the spot who can catch these mistakes and with tact and good sense help straighten out the difficulty will render the best service of all. The man who pleads in excuse, "Nobody told me about that," or "We never have done things that way," or "I never heard of such a case," is confessing that he is more of a machine than a man; that he really needs somebody else present to think for him every time something new comes up.

The above suggestions from a fellow employee are given in a helpful rather than a faultfinding spirit. The standard of intelligence among railroad employees was never higher than this war finds it. The response to most demands made will be intelligent and efficient. Human nature is mighty good stuff and always, under normal conditions, has a little reserve of effort and resourcefulness which is brought out and developed by the abnormal condition of war.

Safety first should always carry signals for common sense second.

Bath Trains Used in War.—The Medical Record states that bath trains are now used extensively by the European armies. These are in use in Austria and Hungary, and also in Servia; doubtless, also, in Germany and France. The trains are provided with sterilizing equipment, usually a refrigerator car into which steam is introduced. When baths are required the hot water is obtained from the locomotive. One of these trains has two cars with thirty bath tubs each, two tank cars to supply the water, one car for undressing, four freight cars with clean linen, a sleeping car for the personnel of the train, and two or three cars for the disinfection of clothing. This arrangement permits 1,200 men in the course of ten hours to take a shower bath and have all their clothing thoroughly sterilized.

Daniel Willard on Part of Railways in the War

"The One Important Thing to Do is to Help Win,' Says Advisory Commission Chairman in Interview

EIGHT months before the Congress of the United States passed the declaration of war against Germany, it passed a law which has proved to be one of the most important measures affecting America's part in the war.

The Army Appropriation Act, which was approved by President Wilson on August 29, 1916, established a Council of National Defense "for the co-ordination of industries and resources for the national security and welfare." This was to consist of six members of the President's Cabinet—the secretaries of War, of the Navy, of the Interior, of Agriculture, of Commerce and of Labor.

The same act directed the Council of National Defense to nominate, and the president to appoint "an Advisory Commission consisting of not more than seven persons, each of whom shall have special knowledge of some industry, public utility or the development of some natural resource, or be otherwise specially qualified" for the performance of such duties as were to be assigned to the commission.

The duties which the Council of National Defense was to perform, and regarding which the Advisory Commission was to assist it, were specifically mentioned. These were to include the direction of investigations and the making of recommendations to the President and the heads of the executive departments of the government regarding various matters. It is highly significant that the first of these matters mentioned were "the location of railroads with reference to the frontier of the United States so as to render possible expeditious concentration of troops and supplies to points of defense; the co-ordination of military, industrial and commercial purposes in the location of extensive highways and branch lines of railroads; utilization of waterways."

Various other matters were mentioned, such as the mobilization of military and naval reserves for defense; the increase of domestic production of materials essential to the support of armies and of the people during the interruption of foreign commerce; the development of sea-going transportation and so on. But it will be seen that the very first duties assigned in this act to the Council of National Defense were those pertaining to the development and use of transportation facilities. As the Council was composed entirely of government officers, it was obviously the intent that the duties especially assigned to it by this law should be performed by it mainly through the Advisory Commission; and since such prominence was given to matters affecting transportation, it was natural and appropriate that the chairmanship of the Advisory Commission should be given to a transportation expert. The man chosen to be chairman, and also to have charge of the Advisory Committee's transportation work, was Daniel Willard, president of the Baltimore & Ohio Railroad.

The date on which the act creating the Council of National Defense and the Advisory Commission was passed shows that it was a peace, not a war measure. Probably it may be more properly said to have been a preparedness measure. The Advisory Commission's original sub-committees were appointed and went to work on this peace basis. When war did come the great amount of work in the direction of preparedness which the commission already had accomplished, and the increased duties which the war put upon it, greatly augmented the importance of an organization which already had begun to play an important part in national affairs.

General Joffre says: "This is a Railway War. The Battle of the Marne was Won by the Railways of France."

One of the first steps the Council of National Defense took after war was declared was to direct Mr. Willard to ask his associates in the railway field to confer as to how the railways could be made more efficient in order that they might better perform their service during the war. It was in deference to this resolution of the Council of National Defense that Mr. Willard called the famous meeting of the presidents of the leading railway systems at Washington, at which they voluntarily undertook to operate all the railways of the country, regardless of their competitive interests, as a national transportation system and at which they created a committee, now known as the "Railroads' War Board," to which was delegated authority over the operation of all the railways in the United States.

Mr. Willard Quotes Gen. Joffre on Railways in War

Speaking in an interview given to the *Railway Age Gazette* in his office in Washington a few days ago, of the part that all American institutions and citizens, but especially American railways and railway employees, must play in the war, Mr. Willard, the chairman of the Advisory Commission, said:

"The one important thing for all to do now is to do the thing that will contribute toward the winning of this war. That is the thought which should be uppermost in the minds of railway managers, of railway officers and of railway employees, just as much as in the minds of the men in the trenches."

Mr. Willard referred to a certain occasion when General Joffre was in Washington on which a number of railway officers called upon him.

"General Joffre made a remark at that time," said Mr. Willard, "which every railway man in this country will be

interested in and should remember. This remark was, in substance: 'The Battle of the Marne was won by the railways of France. It was won by railroad transportation. If the railways of France had not dealt with the mobilization of troops and the handling of munitions and supplies with the efficiency they did, that battle might have been lost, and if we win this war it will be largely due to the railways of France.' Gen. Joffre has also said: 'This is a railway war.'

"Modern war cannot be carried on without good railroad transportation. The railways of the United States have raised nine regiments from among their own officers and employees who will be sent to France to repair and operate the railways behind the military lines in that country. These regiments are composed entirely of men who held good and profitable positions, and yet they are going abroad to do military railway work over there for the pay of ordinary soldiers.

"The vast majority of American railway employees must stay here to operate our transportation system at home but they will have opportunities for service to their country hardly second to those of their brothers in the service who are going to the front. Probably more than half of all the munitions and supplies which the American railway men in France will transport over the railways in that country will have first been carried over our own railways to the seaboard, and it will do little good for the railway men who are going to France to do well their work there, unless the railway employees who remain in the United States do well their work here. The officers and employees of our railways ought to realize that practically every train that they move in this country will contain something which is going to be used directly or indirectly for carrying on military operations oversea; they ought to act accordingly; and I am confident that they will."

Why the Railways Had to Be Co-ordinated

Mr. Willard, as a member of the Advisory Commission on National Defense, sits ex-officio with the Railroads' War Board; but he sits with it as a representative of the government, and not as a railway officer, authority over the operation of the railways being in the hands of the five members of the Railroads' War Board selected by the railways themselves. Mr. Willard dwelt in his interview, however, upon the remarkable way in which the railway executives, from the members of the Railroads' War Board, at Washington, to those in the remote parts of the country, within a very short time began to think in terms of a national transportation system instead of in terms of individual railways.

"The Council of National Defense, on the one hand, and the managers of the railways, on the other," he said, "were confronted with the fact that the railways were going to be obliged to handle a vastly larger traffic than ever before.

"First, we were feeding the world, and it was necessary to call upon the farmers to greatly increase their production, which would result in a large addition to railway traffic.

"Second, we were making guns, munitions and supplies of all kinds for foreign countries, and this had swelled to unprecedented proportions an export business which was daily growing larger.

"Third, we entered the war ourselves, thereby super-imposing on the already enormous traffic an additional traffic consisting of troops and munitions, and including commodities for our own war purposes which were to cost $2,000,000,000.

"It was evident that this was putting upon the railways a burden that they could not carry as they were previously organized and operated. The railroads had not broken down; they were not breaking down. What had happened was that there had been created an entirely new and unexpected situation, and in order to deal with this situation effectively it was necessary for the railways to co-ordinate all their facilities."

The Railroads' War Board is engaged in doing exactly what it undertook to do, namely, to co-ordinate the facilities of all the railways for the purpose of increasing their capacity to the utmost.

Action of the Railways Is Unprecedented

The action which American railways have taken is unprecedented. Never before in the history of any industry in this or any other country did the various concerns belonging to it voluntarily place in the hands of a small committee representing it authority to manage it as a unit, regardless of individual interests, and do this for patriotic reasons and public purposes. An interesting illustration of the disinterestedness with which the roads are acting is afforded by the fact, to which Mr. Willard called attention, that the only positive order which their War Board has issued is one requiring that coal, on which they receive the lowest rates made on any commodity carried in large volume, shall be given preferred movement.

Furthermore, as he said, the government is not paying a cent of the expense incurred by them in carrying on the work and accomplishing the purposes of their War Board, although it amounts to more than the total expense incurred by the Advisory Commission on National Defense. The largeness of the expense incurred is, of course, due to the enormous size of the railroad industry of the United States; and the expenditure is, in effect, a voluntary contribution by the railways toward the prosecution of the war. They are the only industry which is making such a contribution; and yet, while many other industries are making large profits from the war, the railways are confronted with enormously increased costs of labor, materials and equipment, without any assurance of compensating increases of their rates or revenues.

"Whether the railways will be able to carry all the business which will be offered to them is uncertain," said Mr. Willard. "Perhaps some traffic will have to wait. But one thing may be regarded as certain, and this is that they will prove fully equal to the demands for the transportation of troops, munitions, foodstuffs, and other traffic whose prompt movement will be essential to the subsistence of our people, and to our military operations. The railways have been foremost in good work thus far, and they will continue to be."

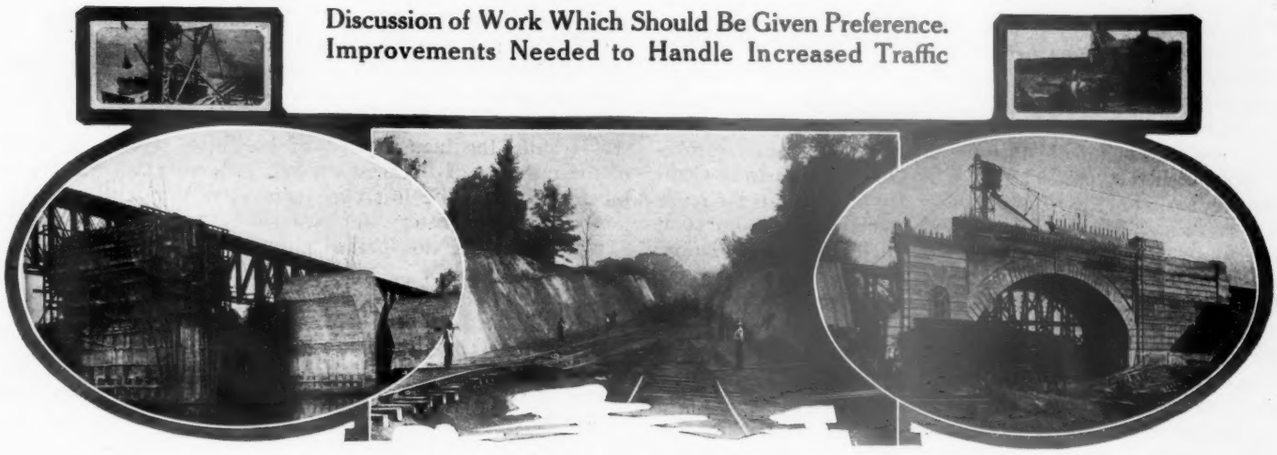
Correlation of Railways and Waterways

The Advisory Commission on National Defense is engaged in trying to develop to the utmost all the country's facilities of transportation additional to the steam railways, and to correlate them to as great an extent as practicable with the steam railways. It has organized a Committee on Waterways, of which General W. M. Black, Chief Engineer of the Engineer Corps of the United States Army is Chairman, and the other members of which are George E. Bartol, Philadelphia; James E. Smith, St. Louis; M. J. Saunders, New Orleans; W. S. Dickey, Kansas City; Captain J. F. Ellison, Cincinnati; and Joy Morton, Chicago. This Committee has had one joint meeting with the Railroads' War Board, for the purpose of developing plans by which the railways and waterways can best be made to work together. It was expected that the Waterways Committee would have another meeting in Washington this week. Special attention is being given to the use which can be made of the Mississippi River, but the entire waterway situation in the country in its relation to the war will be studied.

The Waterways Committee is under the jurisdiction of the Advisory Commission's Transportation Committee, of which Mr. Willard is Chairman. There is also a committee representing the electric railways, which also reports to Mr. Willard. There is, in addition a committee on Motor Truck Transportation, but as Howard E. Coffin, a member of the Advisory Commission, is a prominent manufacturer of automobiles, the Motor Truck Committee reports to him.

Construction Activities During the War

Discussion of Work Which Should Be Given Preference. Improvements Needed to Handle Increased Traffic



ONE of the first questions presented to the railways of the United States following the declaration of war was that regarding the extent to which construction activities should be curtailed during the period of hostilities.

On the one hand, railway construction operations are conducted on such a large scale that they require tremendous quantities of money, labor and materials for which there is now also a great demand in munitions and other industries.

On the other hand, it is of vital importance to our military and industrial success that the roads have sufficient facilities to meet any reasonable demands for transportation which may be made upon them during the next few years.

Because of these conflicting conditions it is important that railway construction activities be analyzed from the standpoint of their relation to the welfare of the country as a whole in order that those projects, if any, which, while desirable, are not necessary, may be postponed and the labor and materials conserved for more urgent work, while at the same time all those improvements which are needed to increase the capacity of the roads or to enable them to operate with a greater degree of efficiency.

In a study of this subject railway construction activities may be divided into two classes—extensive development, or the building of extensions, and intensive development, or the adding of second tracks, the enlargement of terminals and other improvements on existing lines. Because of their widely differing character these two classes of improvements will be discussed separately.

Extensions or new lines may be constructed to reach traffic centers already served by other roads, or to open up for development and settlement areas now without railway facilities. In either case from the standpoint of the railway they are development projects built to secure new traffic and thereby increase the earnings of the road. In normal years 3,000 to 5,000 miles of new lines have been built annually in this country, although during the last two or three years this total has decreased to about 1,000 miles. While this great reduction is abnormal, it is to be expected that the mileage of new lines built will decrease gradually from year to year as the large areas in the west are gradually supplied with railway facilities. However, there is still and will continue to be a demand for additional railway lines for many years.

Following three or four years of relative inactivity, the greatly improved earnings of the roads last year led many of them to plan ambitious programs of development work for this season. As a result a larger mileage of new lines was placed under construction early this spring than for some time and a considerable additional mileage was under consideration when the United States entered the war. As an example of the unusual activity this year, the Atchison, Topeka & Santa Fe has at the present time over 200 miles of new extensions under contract, while practically no work of this character was being carried on by this road a year ago.

The extent to which the construction of extensions should be continued under the present conditions depends in large measure upon local conditions. In some instances a relatively moderate expenditure will provide long needed facilities for a community, while in others the construction of a line may be of important military advantage now as well as of economic value later. In such instances work should, of

Construction Activities

RAILROADS now handling heaviest business in their history.

Facilities overtaxed at many points to the extent of interfering with service.

Large terminals, more and longer passing tracks, additional main tracks and many other facilities urgently needed.

Construction of new lines should be limited so that men and materials may be transferred to improvement of existing lines.

This is no time to retrench in expenditures that will increase capacity because of high cost of material and labor.

It is duty of roads to provide facilities sufficient to handle military and commercial business of the country.

course, be pushed as an economic or military measure. But most extensions are not of this character.

The railroads of Canada offer little precedent for those of the United States in the study of this subject. The severe depression which prevailed in that country in 1914 and 1915 brought to a close the period of over expansion which had existed for several years and placed an effective check on construction activities there. With the return of business conditions to normal, labor became so scarce that the roads have since been unable to undertake a number of improvements which they need badly. The Canadian Railway Commission realizing the situation generally confronting the roads has refrained from ordering them to make expenditures at present which are not essential to their present operation. There is, therefore, almost no construction under way in Canada at the present time.

In general, the extensions built in the United States are designed primarily for development, and the number of persons dependent on these lines for transportation facilities at the time of their construction is relatively small. Also they do not in any way relieve the congestion under which the lines already built are laboring. For this reason the postponement of construction work of this character for the period of the war will not work a great hardship in most cases.

As a matter of public policy it would, therefore, seem advisable to proceed only with the construction of those extensions for which there is immediate need and to transfer energies from the other purely development projects to those for which there is a greater demand. Acting on this idea, one western road which had made all preparations for the construction of an important extension, including the purchase of the right of way and the receiving of bids for the grading before war was declared, postponed the construction of this line in spite of the fact that it had already invested over $1,500,000 in the project. Another road which has placed a considerable mileage of extensions under contract plans to allow the contractors to proceed with the grading as best they can under the present conditions but is not contemplating attempting to complete these lines and place them in service at present.

Shortage of Facilities Along Existing Lines

Conditions are entirely different with reference to the development of existing facilities. Here in general, the primary aim is either to increase the capacity of the facilities or to effect economies of operation. The experience of the last few months has shown how vital is the attainment of the first aim to our military and industrial welfare, while the second object must also be attained if the railways are to continue to overcome rising costs of labor and of materials and to maintain their integrity as investments.

The importance of adequate transportation facilities has been made evident to all by the experience of the last year. While one of the main immediate causes of the congestion was the shortage of boats at the seaboard—a condition entirely beyond the control of the railways—the tremendous increase in traffic has found the roads unprepared in many instances, and this has contributed materially to the difficulty. Even after discounting the greatly exaggerated claims of certain groups of shippers and their advocates, it must be admitted that the roads are unable to handle the traffic offered to them with the customary promptness and that business is suffering as a result.

It is hazardous to attempt to predict the trend of traffic at any time and particularly so during the war. At the same time the study of certain conditions will assist in the formation of an estimate of the probable tendencies of railway business. Immediately following the outbreak of the war the Canadian railways suffered a very severe reduction in business, although this depression had started before the war and would undoubtedly have developed in large measure if there had been no hostilities, for it was the natural result of a long period of over expansion, particularly in Western Canada. After an interval of severe depression during the first 18 months of the war business began to revive, and today in spite of the war and the severe shortage of labor the railroads of that country are handling the heaviest traffic in their history. The railways of France and those of England also have shown great increases in traffic since the inauguration of hostilities. In fact, some of the railways of France have had to handle twice as much business during the last two years as during any previous period in their history.

The United States passed through the same period of depression in 1914 and 1915 that was felt in Canada, and the roads of this country have also experienced the same rapid recovery in business. It is, therefore, not to be expected that our recent entrance into the war will create a further depression in business, but rather it is practically certain to add to the widespread industrial activity because of our part in financing and supplying our allies with war materials and foodstuffs of all kinds in addition to handling the normal business of this country. The railways of the United States may, therefore, expect with considerable certainty to be confronted with an even heavier traffic than they are now handling. Much of it must also be transported promptly to support the operations of our forces and those of the allies at the front.

In addition to the extraordinarily heavy commercial business which may be expected the railways will undoubtedly be called upon to handle a very heavy movement of troops and their supplies entirely aside from the National Guard and the regular army. The mobilization of 500,000 troops in the training camps is alone equivalent to the establishment of a group of new cities with aggregate populations of the amount mentioned, which must be supplied with materials and food stuffs. The problem of transporting these men to the camps, of providing them with the necessary supplies while there and of moving them from place to place is a problem, the magnitude of which is not realized at present.

Entirely aside from the unusual increase in traffic of the last year and that which will result from the movement of troops and supplies there is a normal increase in both passenger and freight business from year to year. Taking the average for the last 25 years, this annual increase in freight traffic has been over 12.5 per cent and in passenger traffic 6.5 per cent. In other words, freight traffic has doubled about every 8 years and passenger traffic about every 16 years. It is, therefore, necessary for the railways to add to their facilities continually if they are to keep pace with the growth of the traffic offered to them.

The magnitude of these current expenditures for additional facilities is not commonly realized. While testifying last month before the Interstate Commerce Commission in the hearing on the application of the railroads for increased freight rates A. W. Thompson, vice-president of the Baltimore & Ohio, stated that for the last 10 years this road has spent over $18,000,000 annually for betterments, including additions to equipment, and that it now has on its program improvements which should be done within the next two years aggregating $54,000,000, of which $38,000,000 is for improvements to roadway and structures alone. L. E. Johnson, president of the Norfolk & Western, presented testimony at the same hearing to the effect that this road of less than 2,100 miles had expended $87,664,876 for additions to road and equipment during the 9 years ending June 30, 1916, and that it should spend $15,000,000 this year for improvements to roadway and structures alone if it was to meet the demands made upon it by the traffic.

The magnitude of the expenditures for additions and

betterments for all of the roads of the United States is correspondingly great. The report of the Interstate Commerce Commission for the fiscal year ending June 30, 1914, shows the expenditures of this nature for that year to be $516,061,290, while those for the preceding year were $545,989,342 or over four times the amount spent for extensions. While these figures include both the road and equipment accounts, by far the largest part was for additions to roadway and structures.

It should also be borne in mind that the two years previous to 1916 were ones of general business depression and greatly reduced railway earnings. As a result, there was neither the immediate demand for additional facilities nor the funds for their construction and the amount of improvement work was greatly curtailed. As a result when traffic increased so rapidly late in 1915 and during 1916 the roads did not then have an opportunity to make up for the time which they had lost. This fact contributed materially to the congestion of last winter. Had the development of railway facilities been continued during the depression of 1914 and 1915 many of the improvements now needed would be available. Unfortunately, the policy of regulation under which the roads of this country have been laboring during recent years has so reduced the earnings of many of them that they have not a sufficient reserve with which to continue improvement work of this character on other than a hand to mouth basis.

The value of adequate railway facilities to the roads, and also to the country as a whole, is indicated by the relative performances of a number of systems during the period of unusual traffic of the past year. Roads such as the Santa Fe, the Illinois Central, the Norfolk & Western, the Burlington and the Union Pacific, which have made large expenditures for additions and betterments during the last few years were able to handle materially increased business with relatively little congestion except that caused by the inability of connecting lines to accept cars from them. These roads were able also to convert a large proportion of the increased gross earnings into net, while roads in the same vicinity and sharing in the increased business but which had not made these improvements were more seriously congested and were required to spend a larger part of their increased revenues in operation. It is plainly evident that those roads which were able to take advantage of this enlarged business to increase their net earnings for their owners were also rendering more valuable service to the country through their ability to handle this traffic efficiently. No more striking proof could be afforded of the value to the nation of adequate development of railway facilities. This is not a time for retrenchment in the provision of facilities, nor is their provision now a matter which primarily affects railways and shippers. It is vital to the country that the railways be able to handle the military traffic and the regular commercial business with reasonable facility, and a sound public policy should see that the railways secure a sufficient return for their services to enable them to provide these facilities.

Making Improvements to Existing Property

Improvements to existing property may be divided between those designed to increase the capacity of the line directly or through increased regularity of operation, and those which will reduce the cost of operation. Many of the facilities most seriously needed are those of the first class, including new and enlarged freight terminals and modern freight houses, second tracks, etc. Among the improvements which tend to promote regularity of operation are plants for the treatment of water in territories with bad water conditions to reduce the number of engine failures, etc. Improvements which will reduce the cost of operation and also aid in increasing the capacity of a line and in insuring regularity of operation include the reduction of grades, the replacement of obsolete coaling stations with those of modern design, etc.

Railway facilities are most seriously inadequate at terminals. Although large expenditures have been made for the enlargement of yards since the congestion of 1907, these expenditures have not kept pace with the increase in traffic and it is here that the railways still suffer from congestion first. In the majority of instances the lines between terminals can handle far more business than the terminals can deliver to them. However, it is not alone in the terminals that the railways can improve their facilities to advantage. In many instances new passing tracks will reduce the delays to trains while the extension of others will aid in the handling of longer trains. The strengthening of bridges will permit the operation of heavier trains while the interlocking of railway grade crossings will reduce delays. These illustrate the wide variety of additions to railway facilities which are needed and with which railway men are fully familiar.

It is true that labor is scarce at the present time and that as a result wage rates are abnormally high and the efficiency of the men is lower than usual. Also, many materials are now abnormally high, particularly steel products. These factors will, of course, materially increase the cost of much of the work which should be done. At the same time, these conditions should not lead the roads to defer improvements which will provide needed increases in capacity. The roads owe it to the country to proceed with work of this kind as rapidly as conditions will permit in order that they may be able to handle the traffic which will come to them. Rather than attempting to retrench in expenditures for improvements of this kind because of the high costs of labor and materials, it should be the policy of the roads, and particularly of those which have been more seriously congested during the past year, to carry on all those improvements for which they can secure the men and the materials.

In determining which of the many projects should be undertaken, preference should naturally be given to those for which there is the greatest need and to that work which can be done most rapidly under the conditions which exist in the labor and material markets. Obviously there are certain improvements which, although desirable, are less important to the welfare of the country and the railways at present, than others. Typical of this class may be mentioned many large passenger station projects. While modern stations are desirable, in many instances the continued use of the existing facilities, although perhaps inconvenient and inadequate, will work no great hardship on the public or restrict travel, while the use of the money, the men and the materials they would require on other projects, such as the enlargement of freight terminals, may result in greater immediate benefit.

Such considerations point to the importance of preparing carefully a budget of improvements and rating the various projects with respect to their relative immediate importance. In studying the problem, the matter of providing increased capacity at congested points should be given the greatest weight; while work needed primarily because of its effect in reducing the cost of operation should be considered next.

Another important consideration in arriving at a program of the improvement work to be done is that of the relative amounts of labor and materials required. Other things being equal, it is evident that the greatest benefit will result from giving precedence to those improvements which will suffer least from existing conditions in the labor and material markets. Steel is not only high in price at the present time, but deliveries are also badly delayed and some of the manufacturers are withdrawing entirely from the market. As a result, the cost of work involving

a considerable tonnage of steel work is increased greatly, while the completion of projects of this character is postponed. Other forms of construction where concrete or timber can be employed are not subject to the same handicaps. Because of this fact the chief engineer of one important western road is giving precedence to projects consisting largely of concrete construction because of his ability to complete them with relatively little delay and at no great increase in cost over normal conditions. For the same reason this road is proceeding with those projects, a large amount of the work on which consists of grading, as it is possible to carry on such work under conditions not far from normal.

By studying each project in this way, by selecting those materials which will give the desired results with the minimum inconvenience and increase in cost, and by so organizing the work as to use the minimum amount of labor a normal improvement program can undoubtedly be maintained and new facilities placed in service at a time when they will be of great benefit to the roads directly and also to the public through the increased service the roads will be able to render.

Another method of handling improvement work which is receiving increased attention because of conditions existing in the labor market is that of contracting work on a cost plus percentage basis instead of at a flat unit price. Conditions with reference to labor are so uncertain that if a contractor is to bid on a piece of work which will be completed several months in the future he is forced to set a high figure in order to protect himself. By contracting for improvement work on a cost plus percentage figure a road itself assumes the risk of changes in wages and prices, and probably will get off cheaper. In a few instances contracts have also been placed on the basis of cost plus a fixed sum. This latter plan would seem to warrant careful consideration because of the fact that it removes the incentive for the contractor to run up the cost of the work.

In brief, the railways have not kept pace in the development of their facilities with the increase of traffic. They are confronted with the heaviest business in their history, and the indications are that the high point already reached will be greatly surpassed before the conclusion of the war. They now need additional facilities at many points in order to handle the business offered to them, and still other facilities would yield good returns on the investment through decreased cost of operation. It is not now advisable or possible to undertake a widespread campaign of heavy reconstruction work, or to plan long extensions. It is equally inadvisable to retrench in expenditures for improvements. Rather, a concentrated effort should be made to so employ the labor and the materials available as to secure, first, the greatest practicable increases in increased capacity, and, second, the greatest practicable economies in operation. By serving themselves in this way the roads will also be serving their country.

The Senate Passes the Priority Bill

Amended Bill Goes to the House—Interstate Commerce Commissioner Judson C. Clement Dies Suddenly

WASHINGTON, D. C., June 19, 1917.

THE Senate on June 16 passed without a record vote the priority bill urged by the administration, authorizing the President, through an agency to be appointed by him, to issue orders to the Railroad War Board that certain traffic shall be given preference in transportation during the war. As rewritten on the floor of the Senate the bill contains numerous modifications from the form in which it was originally introduced and from that in which it was reported from the Committee on Interstate Commerce. As it goes to the House the bill provides:

"That during the continuance of the war in which the United States is now engaged, the President is authorized, if he finds it necessary for the successful prosecution of the war, to direct that such traffic or such shipments of commodities as may be essential to the prosecution of the war shall have preference or priority in transportation by any common carrier by railroad or water, under such rules and regulations as he may prescribe."

This amendment was proposed by Senator Nelson of Minnesota to meet the objections of several senators to the broad language proposed in the original bill, which authorized priority orders whenever, in the judgment of the President, "such action is necessary to the public security and defense."

The bill had been the subject of prolonged debate in the Senate for over a week and had been strenuously opposed, particularly by Senators Reed of Missouri, and Smith and Hardwick of Georgia, on the ground that it placed too great power in the hands of the President or of the person or persons appointed by him to determine what traffic should be given preference. One of the principal points of objection also was that it provided for compensation for the railroads, to be determined by the Interstate Commerce Commission, for damage suffered by reason of giving preference or priority, or by reason of disarrangement of traffic caused by compliance with a priority order, while allowing no compensation to a shipper whose business might be damaged. It was shown by the friends of the bill, led by Senators Newlands and Cummins, that to attempt to provide for compensation to shippers would open the door to an avalanche of claims against the government on account of any delay or failure to receive a full car supply, and as a compromise the entire provision for damages to carriers was stricken out.

An unsuccessful effort was made in a conference between Senators to agree on a compromise by which the President or his representative would determine priority as to materials of war, while as to other traffic the question should be determined by the Interstate Commerce Commission. Several Senators wanted the entire decision as to priority of shipments left to the Interstate Commerce Commission, but this was objected to on the ground that it would not be consistent with the functions of the commission to require it to order discriminations. As passed, the bill provides that the President may give instructions as to priority "at and for such times as he may determine, and may modify, change, suspend or annul them, and for any such purpose he is hereby authorized to issue orders direct or through such person or persons as he may designate for the purpose." Officials of the United States when so designated shall receive no compensation. Persons not in the employ of the United States shall receive such compensation as the President may fix. Provision is also made for suitable offices and necessary expenses. Carriers are directed and required to establish and maintain continuously in Washington during the period of the war "an agency by a committee of railroad officers or otherwise, fully empowered by such carriers to receive on behalf of all the carriers notice and service of such

orders and directions and to arrange for the prompt compliance therewith by such carriers." Any failure knowingly and wilfully to comply is made subject to penalties. Qualified approval of agreements between railroads for division of earnings in certain cases is given by a provision that:

"The President is hereby authorized, whenever in his judgment it becomes necessary in order to expedite and provide for needed transportation and to do justice between carriers, to permit and authorize carriers to enter into agreements looking to a proper and equitable division of earnings for such time as may be specified and upon kinds of traffic to be prescribed, such agreement in each instance to be approved by the President or his duly authorized representative." This provision was strenuously opposed for a time by Senator Reed, who asserted it would legalize pooling and who finally offered the amendment, which was adopted, requiring the approval of the President or his representative of each agreement.

Compensation for the railways for service performed is provided as follows: "For the transportation of persons or property in carrying out the orders and directions of the President, the lawfully established tariffs shall apply unless otherwise fixed by law; for the transportation of troops in carrying out the orders and directions of the President reasonable rates shall be fixed by the Interstate Commerce Commission; and if the transportation be for the government of the United States it shall be paid for currently or monthly by the Secretary of the Treasury out of any funds not otherwise appropriated."

The bill as passed contains the original provision that "any carrier complying with any such order or direction herein authorized, shall be exempt from any and all provisions in existing law imposing civil or criminal pains, penalties, obligations or liabilities upon carriers on account of any such action." This would prevent interference with the carrying out of an order to give preference to certain traffic by state laws or orders of state commissions and would also remove any question of violation of the Sherman law.

Senator Reed also secured the adoption of an additional section at the end of the bill, authorizing the Interstate Commerce Commission after proper investigation and hearing "to require the various railway companies of the United States engaged in interstate commerce to provide with all possible dispatch sufficient cars and equipment to promptly move and transport all traffic tendered to them, and it is hereby made the duty of the several railway companies to comply with such orders when so made."

Section 1 of the bill as passed is a prohibition against obstructing or retarding the orderly conduct or movement of interstate or foreign commerce and authorizes the President to employ the armed forces of the United States to prevent any such obstruction or retardation of interstate or foreign commerce or of the passage of mail.

Much of the debate on the bill revolved around the question of the comparative rights of railroads and shippers to the collection of damages. It was pointed out that if a railroad were ordered to devote its facilities for a time to certain traffic needed for the prosecution of the war, some of the shippers along its line might be ruined. To this the sponsors for the bill replied that the government could not undertake to compensate for all damage and inconvenience that might be suffered on account of the war, but that the railroads occupied a different position from that of individual shippers in this respect. Senator Jones of Washington called attention to a circular issued by the Northern Pacific Railway to northwestern fruit growers advising them that on account of the war it may be impossible at harvest time to furnish equipment enough to take care of the movement of perishable commodities and that it would be well if growers and shippers of perishable commodities would provide frost-proof storage in order to take care of their crops this fall. Later on he put into the record a letter from the acting secretary of agriculture stating that the principal point to which the Northern Pacific apparently wished to call attention was the necessity for more storage warehouses to take care of such part of the fruit as does not necessarily have to be moved to market immediately. At a conference between the representatives of the department and the Railroad War Board on the subject it was ascertained that the latter, immediately on receipt of a copy of the circular, had called it to the attention of the president of the Northern Pacific and asked him to correct the impression under which it had left shippers.

Death of Commissioner Clements

The sudden death this week of Judson C. Clements will place in the hands of President Wilson the appointment of three additional members of the Interstate Commerce Commission, if the bill which has passed the Senate and is now pending in the House becomes a law, and as he appointed Commissioners Hall and Daniels, a majority of the nine members provided for by the proposed bill will be his appointees. Chairman Adamson of the House Committee on Interstate and Foreign Commerce made an effort to secure the passage of the bill on June 13, but after considerable debate its consideration was postponed. The bill for the enlargement of the commission has previously passed the House twice, on the last occasion in practically its present form, providing for the organization of the commission into divisions. As passed by the Senate it contains the Smith amendment requiring the commission to suspend a proposed rate advance against which protest is made. As reported to the House this provision was not included and Chairman Adamson suggested that the House bill be passed and the amendment considered in conference. During the debate Representative Walsh said that one of the reasons for increasing the size of the commission was the amount of work entailed by the valuation and that it might be better for Congress to pass an act discontinuing the work "that is going to be absolutely worthless when completed." Mr. Adamson offered an amendment to the provision authorizing a division to act for the commission, adding the words "subject to revision by the commission when demanded by either party interested." Mr. Sims proposed an amendment to require the suspension of an advanced rate. The bill will be again considered this week.

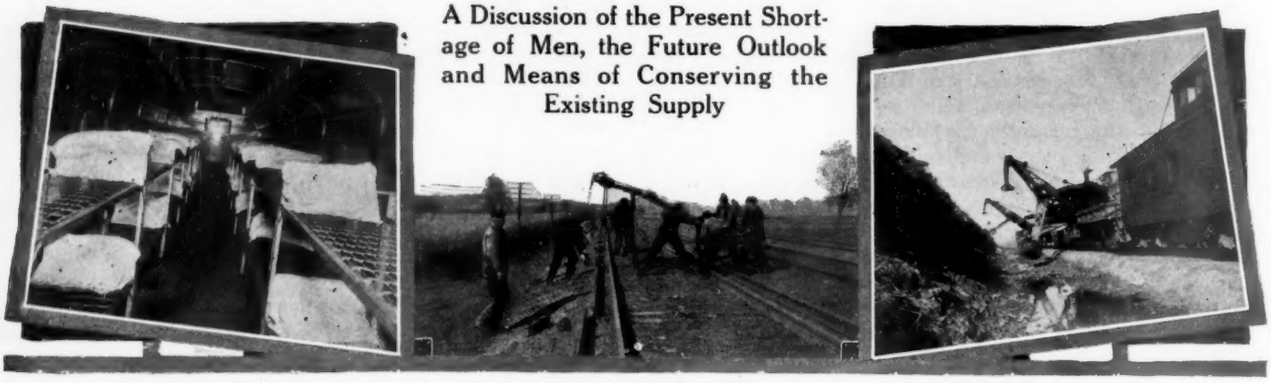
The passing of Judge Clements at this time has led to some speculation as to its possible bearing on the decision of the Interstate Commerce Commission in the rate advance case. From the questions he had asked during the recent hearing of the case, as well as the position he had assumed in previous rate cases, there had been a general impression that he would oppose the application of the carriers for a general 15 per cent increase. As the time within which a decision must be rendered is so short that it is considered impossible for a new commissioner to take part, the possibility arises that the commission might find itself divided three to three on the question as to whether the railroads' application should be granted, and unless there should be an affirmative decision that the proposed rates should be suspended by July 1 the blanket tariffs filed by the roads would automatically go into effect on that date.

Candidates for the I. C. C.

Members of Congress are busy in the interest of various candidates for appointment to the Commission. Senators Simmons and Overman of North Carolina have been recommending to the President, Edward L. Travis, chairman of the North Carolina Corporation Commission. Other names presented include those of former Senators Clapp of Minnesota and Kern of Indiana, and former Representative Fred C. Stevens of Minnesota.

The Maintenance of Way Labor Problem

A Discussion of the Present Shortage of Men, the Future Outlook and Means of Conserving the Existing Supply



Better Sleeping Quarters *Less Men to Relay Rail* *Saving Men and Time in Ditching*

AT the present time when not only the prosperity of the country, but its very existence may be dependent upon the continuance of adequate transportation facilities, it is of vital importance that the railways be maintained in a condition which will enable them to meet any demands which may reasonably be made on them.

As the railway tracks and structures are the foundation over which the traffic must move, it is self-evident that their maintenance is vital to the conduct of transportation and that they must be maintained at least to existing standards and in many cases in better condition than ever before, for no one can now anticipate the maximum requirements which may confront them in the near future.

It is not expected that they will be called upon to handle as heavy movements of troops and military supplies as some of the European railways (the London & Northwestern handled 15,000 special trains in the first six months of the war), but this is not beyond the realm of possibility. It is not only a sound business policy but a patriotic duty as well for the railways to take all reasonable precautions now against a possible breakdown in their facilities later when such a condition might lead to national disaster.

One need only observe the conditions now existing on the European railways to realize the results of neglect to maintain their properties adequately during the last three years. The United States Government has already called for nine regiments of railway men to go from this country to France to reconstruct and operate sections of the railways of that country, and five of these regiments are to be composed of maintenance of way men. The condition of the Russian railways is equally serious. George Bury, vice-president of the Canadian Pacific, has returned within the last few weeks from a three months' study of the Russian railways made at the request of David Lloyd-George, prime minister of England. Since his return a commission of prominent American railway engineers has been sent to Russia by the United States Government to assist in the reorganization of these roads so that they may be able to perform the service necessary for the defense of their country.

Less is known about the condition of the German railways, but reports reaching the United States indicate that equally serious conditions exist on the railways of that country. Students of conditions in Germany have predicted that the ultimate collapse of this country's military power will be hastened by this disintegration of transportation facilities.

The American railways cannot afford to incur any risk of a deterioration of their properties because of the demand for men and materials in other industries, and the recent entrance of our country into the European conflict only serves to make more necessary the adequate maintenance of our roads

Equally important are considerations affecting the conditions which will exist after the termination of the conflict. Leading authorities on world conditions are united in the opinion that the years immediately following the conclusion of hostilities will see the most severe competition for trade ever known and that every resource of our country should be prepared to assume its full part in sustaining our industries during the period of adjustment and transformation from military to commercial activities. In this struggle for business the railways of this country will be of vital importance, for without efficient transportation for movement of raw materials to factories as well as of the finished products to the seaboard, there can be little effective competition by our industrial and commercial interests with those of other countries.

Many railway officers are already realizing the importance

Maintenance Labor Situation

PROPER maintenance is more than usually necessary during the war.

A considerable amount of deferred maintenance has accumulated during the last three years and should be taken up.

The shortage of labor which now exists will continue.

Living and working conditions should be improved in order to hold men in the service.

Lengthening the working season will increase the amount of work performed.

Labor-saving eqnipment should be employed to replace men wherever possible.

of their responsibility in this regard. The instructions issued by Hale Holden, president of the Chicago, Burlington & Quincy, that under no circumstances must the properties under his direction be allowed to deteriorate and that all expenditures for their upkeep must be continued as usual, illustrate the attitude of many roads and should be the universal practice. Retrenchment in maintenance of way expenditures at the present time is unwise and may even be suicidal. Even with the high price of labor and materials, work can in most cases be done as cheaply now as later because of the recognized fact that deferred repairs cost much more in consequence of the accelerated rate at which deterioration takes place.

Conditions Before the War

In discussing the policies to be followed in maintaining the fixed properties during the ensuing months it is well to consider the condition in which they were at the beginning of the war. In the fiscal year ending on June 30, 1913, the railroads of the United States reached the highest point of operating revenues in their history up to that time and expenditures for maintenance of way likewise touched a high figure of over $421,000,000. The following year saw a decline of over $78,000,000 in operating revenues, and while this led to retrenchment in maintenance of way work, it was impracticable to stop much of it before the close of the year and the decline in expenditures was relatively small. The fiscal year ending June 30, 1915, saw the full effects of the outbreak of the European war and there was a heavy decrease in gross revenues and a reduction of over $28,000,000 in expenditures for the maintenance of the tracks and structures. This severe retrenchment, following the slight retrenchment of the preceding year, led to the accumulation of a considerable amount of deferred maintenance.

Late in the summer of 1915 business picked up very rapidly. This revival continued during the winter and resulted in the heaviest business in the history of the railways for the fiscal year ending June 30, 1916. This rush of business came so late in the fall of 1915 that it was impossible for the maintenance of way department to take advantage of the heavier earnings that season, with the result that while the expenditures for the fiscal year ending June 30, 1916, were heavier than those for the preceding year, they did not reach the total for 1914 or for 1913, so that there was a still further accumulation of deferred maintenance because of the increased wear and tear resulting from the heavier business.

During 1916 a new factor served to complicate this problem still further. While the increased traffic made possible more liberal allowances for maintenance work, the widespread industrial activity which gave rise to this traffic resulted in such a shortage of labor that it was impossible for the roads to secure the number of men necessary to handle the work authorized and for which the money was available. The result of this shortage of labor was a general increase in wage rates. This condition combined with the rising costs of material and the decreased efficiency of labor which usually accompanies a shortage of labor, considerably reduced the amount of constructive work secured per dollar of expenditure, and made the comparison of maintenance performance with previous years still more unfavorable. This labor condition has continued with increasing severity up to the present time.

As a result our entrance into the war finds the railways of the United States handling the heaviest business in their history with a correspondingly great wear and tear on the property, while maintenance has been below normal since 1913 and there has accumulated a considerable amount of deferred maintenance. The roads cannot, therefore, be considered to be entering the war with the decks cleared, which makes it all the more important for them to maintain their properties to the highest standards possible and not to consider retrenchment in any way.

The Shortage of Labor

In conducting maintenance of way operations during the war present indications are that the limiting factor governing the amount of work to be done will be that of the number of men available, a continuation of the situation existing in 1916. The past three years have seen a great decrease in the number of men seeking railway maintenance of way work. Although the expenditures for the maintenance of the roadway and structures in 1913 exceeded those of any previous year by over $50,000,000 there was only a slight shortage of labor, such as would be encountered in any period of general industrial activity and the completion of the season's work was not seriously retarded.

War was declared in the middle of the working season of 1914 and large numbers of Italians, Austrians and men of other nationalities commonly employed in track work were called home to engage in the hostilities. The heavy slump in business during the period of uncertainty immediately after the outbreak of hostilities also resulted in a severe curtailment of work in almost all industries, so that a widespread reduction in forces was made practically simultaneously with the emigration of these men to Europe and the scarcity of men did not handicap operations to any extent. The following year witnessed a continuance of this depression and the further withdrawal of laborers from this country.

Late in 1915 the rapid revival in business greatly increased the demand for men. Because of the materially reduced supply, the industries which were undertaking work on large and profitable war orders found it necessary to raise wages and secure the men required by drawing large numbers from railway service. This competition was particularly acute in the territory east of Chicago and especially in the vicinity of the large industrial centers, although it has existed to a large extent elsewhere. In many instances not only the laborers but the foremen as well have been attracted into this work because of the high wages paid. As a result it has been difficult and in many cases impossible to retain large gangs for ballasting and rail renewal operations and the men have been more transitory than usual. As an indication of conditions in the industrial centers, labor became so scarce in the vicinity of Detroit last year that the only way in which some of the roads could handle ordinary section work was to move in gangs from outlying territory for a couple of days and then send them back before labor agents could locate them and entice them into the factories.

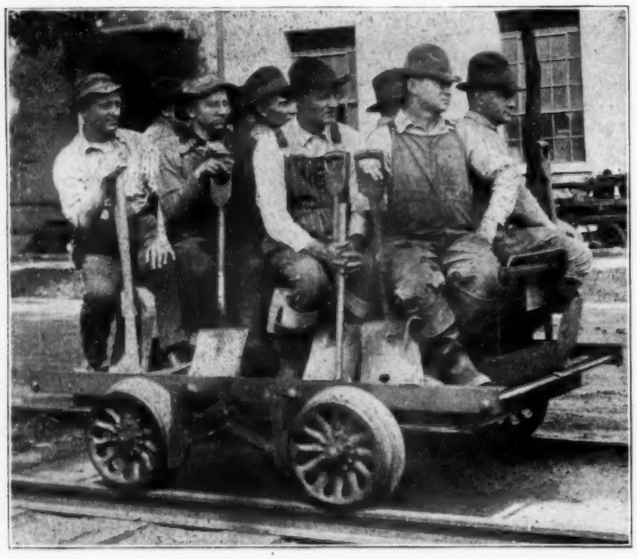
This great demand for labor in other industries will undoubtedly continue until the conclusion of hostilities leads to a cessation of activity in the plants engaged in the manufacture of war materials. Already there are evidences of some decrease in the amount of munitions to be exported from this country for use by the Allies. In a number of instances plants which have completed the original contracts for which they were built are now idle. In other instances, particularly in Canada, factories which have been engaged in the manufacture of munitions are now receiving orders for shell forgings only and the loading of the shells is being done in England where the output of the munition factories is increasing rapidly. It is understood in some quarters in Canada that the manufacture of finished munitions will be very largely reduced if not entirely discontinued this fall. If this is the case it will release a considerable number of workers for employment in other industries and will relieve the stringency somewhat.

With the entrance of the United States into the war, our country will require greatly increased quantities of munitions for the use of its forces and large demands will undoubtedly be made on the factories fitted for this class of

work. This will require large forces of men, probably considerably more than will be released from the plants which have been working on foreign orders so that the net result will be an increased shortage of men.

Contrary to one's possible first impressions, the sending of large forces to Europe will probably not interfere seriously with track labor directly. While Canada has not yet passed a conscription law, the experience of the Canadian railways with enlistment is indicative in some measure of the probable effect of recruiting activities on the railroads of the United States. At the present time, although over 8,000 employees of the Canadian Pacific have enlisted for military service relatively few of these men have gone from the maintenance of way department other than from among the officers and engineering employees. In most instances, the foremen are too old for efficient military service, while in Ontario and the Western provinces the laborers are very largely foreign, and are not enlisting in any numbers. In Quebec and the maritime provinces track labor is very largely native, but owing to local conditions the number of enlistments in these provinces has been relatively small.

At the present time it is not possible to determine the extent to which conscription will affect the maintenance of way department in the United States. The government has indicated its intention to exempt the men employed in certain industries necessary to tbe maintenance of military operations. While it has not specified the industries which will be so exempted, it is expected that the railways will be included in such a list, and that, therefore, the maintenance of way department will lose few if any men by conscription. However, the large proportion of the track laborers of this country are of foreign citizenship which renders them immune from compulsory military service under any conditions. The most serious effect on the railway labor supply will undoubtedly be indirect, for the higher wages paid by other industries will attract many men into the factories to replace



The Motor Car Saves Labor

those drawn from these plants into military service, aggravating the condition which has existed during the past year.

The avenues of possible relief from the shortage of labor in the maintenance of way department are the bringing of other workers into this service, the reduction of the amount of work to be done to the capacity of the forces at hand, the conservation of the available forces by the adoption of improved methods of handling men and conducting work, and the adoption of labor saving equipment wherever possible to increase the efficiency of the men.

Cannot Expect to Attract New Labor

At this time when other industries are attracting large numbers of men from railway service there is no possibility of the roads increasing their forces by drawing men from them. To hold the men they require these industries are now paying and will continue to pay wages higher than those which the roads can afford to offer. The railroads employ such large numbers of laborers that any increase in wages on their part only forces competing industries to raise their rates accordingly and will not bring any considerable number of men into railway service.

Shipping new men from a distance into active industrial communities is also of doubtful value at present. Several of the northern roads brought large numbers of negroes north last year only to find that these men left their employ to go

Using a Side Dump Car to Haul Away Station and Dining Car Refuse

to the factories in a few days, attracted by the higher wages. The chief engineer of one road which brought north over 10,000 negroes last season found that he did not have 1,000 of these men at work on his line at any one time.

An interesting possibility in this connection, not only for the railways but for the industries in general, is suggested by the offer made to the Council of National Defense by a Western Chinese organization to bring 500,000 Chinese laborers into this country to alleviate the present shortage and to replace the men who will be called into military service. With the shutting off of a large part of the European immigration permanently by the alien labor law which went into effect on May 1 and the probable decrease in Mexican immigration when conditions return to normal in that country, a number of prominent western railway men have considered that some such action would be necessary ultimately. However, the railways can expect no relief from this source for the present.

Much publicity has been given to the suggestion of employing women in place of men on the railways. Here, again, Canada offers a precedent for the roads in this country. Many women have replaced men in clerical positions on the Canadian roads and some have been employed in the car and locomotive shops. But it has not been considered practicable to employ them to any extent in the maintenance of way department outside of the offices. It is not to be expected that the railroads of the United States can secure any more relief in this direction than those of Canada have. Women may replace men as crossing watchmen, time keepers, etc., but the number that it will be advisable to employ in this way will be so limited that it will have no appreciable effect on the shortage of men.

Improving Living and Working Conditions

As pointed out above this is not the time to retrench in the maintenance of railway tracks and structures. Since no considerable addition to the forces can be expected from the outside the problem resolves itself into the most intelligent utilization of the existing supply in order to complete as nearly as possible the large amount of work at hand. This leads at once to the conclusion that the forces should be conserved for that work most important to the operation of the railways. The offers of certain railway managements to

loan their section laborers to the farmers along their lines, while prompted by good motives were unwise. The granting of time during working hours to maintenance of way employees to tend their gardens as an incentive to greater production of foodstuffs is also questionable. With the supply of track labor as limited as it now is the diversion of any considerable number of men available for work on the railways to other work cannot help but seriously affect maintenance. As much as agricultural activities need to be encouraged this year, the fact remains that efficient railways are equally necessary, and that the diversion of men from one kind of work to the other is simply "robbing Peter to pay Paul."

It is vital that the roads make special efforts to retain in their services all of the labor recruited for their work. This

Mowing Weeds with a Motor-Operated Machine

leads up to the study of the working and living conditions of track labor, the results of which will be applicable not only at present but also in succeeding years. The prevailing surplus of labor in this country until recently has resulted in the establishment of certain practices in railway work which have long tended to drive men into other industries. This is particularly the case when there is a shortage of men and they are able to be more independent in choosing the work they will undertake. The labor turnover today is unnecessarily high, and the continual training of inexperienced men only to have them go to other industries in a short time is a great drain on the efficiency of the maintenance of way department. Among the railway practices which are in disfavor with labor are the hiring of men through private labor agents who are responsible neither to the roads nor to the men, and contracting of the feeding of many classes of floating gang laborers to outside parties, the provision of poor housing accommodations not only for the men in the floating gangs but for many section laborers as well, and irregular and spasmodic employment.

At the present time when men are so greatly in demand individual roads are giving more consideration to the correction of these abuses than ever before. One of the most important developments has been the establishment of company labor bureaus on a few roads. The Baltimore & Ohio organized its own bureau about three years ago, and several other lines are considering similar steps to protect the men entering their employ from extortion and to insure some measure of supervision over their selection.

The consideration of company boarding accommodations has not received the attention it deserves, although probably as many men leave railway service because of dissatisfaction with the food provided for them as from any other cause. In spite of the fact that contractors have long realized the value of good board as a means of holding men, the railways have almost entirely ignored this factor and have handled the boarding in a way to require the least attention on their part and with little consideration of the welfare of the men. The complete overhauling of the methods of feeding laborers will do as much to hold men in railway service as any other measure which can be adopted.

The greatest betterment in living conditions is being made through improvements in the character of the cars and of the camps provided, although a great deal of work still remains to be done to bring the standards of housing up to the proper level. When the roads awake to the fact that satisfactory boarding and housing arrangements figure strongly in comparison with wages in the minds of the men commonly employed in maintenance of way, further improvements in this respect will be made which will result ultimately in important reductions in expenses.

A great improvement can also be made by lengthening the season of employment in maintenance of way work, particularly in track work. A number of roads, including the Long Island, the Lehigh Valley, the Frisco and the Burlington have made distinct progress in this respect. The change in the fiscal year, so that it now terminates December 31, instead of June 30, removes the obstacle previously raised to the inauguration of work early in the spring. It is difficult to understand the indifference of many of the roads to the fact that the amount of work which can be performed by a given number of men is dependent directly upon the length of the working season. Numerous more or less valid objections are raised to the practice of maintaining uniform forces throughout the year, but the fact remains that most roads can work a longer season and can also employ a larger force on productive work throughout the winter than they now do with resultant economy to themselves. If the present shortage of labor overcomes the inertia of railway men in this respect it will have accomplished a result of great permanent value to the maintenance of way department.

Another basic handicap in the retention of men in the maintenance of way department is the lack of reward for individual efficiency. It is the almost universal practice to pay a uniform wage to all men in a gang, experienced or inexperienced. It has been suggested that if the rate were increased slightly at certain intervals, and this fact were made known to the men, it would afford an incentive for some of the better ones to remain in the service.

There also exists an opportunity for the development of some system by which individual or gang efficiency can be rewarded. The Baltimore & Ohio has developed and now

Saving Labor by Widening an Embankment with Air-Operated Dump Cars

has in effect on a number of divisions an elaborate system by which the earnings of the men are increased in accordance with the increase in their output of work. Several other roads are working on similar systems. In spite of the many objections directed at these so-called efficiency systems, they have merit, and continued study and experimentation is certain to result in the development of plans of great practical value. The maintenance of way department is fortunate in the opportunity it has to develop plans of this character because of the fact that the men are not generally organized and the opposition of organized labor will not, therefore, be encountered. More scientific methods in the

handling of labor in this department will come eventually and will result in mutual benefit to the roads and the employees, but there never will be a period in which the results will be more valuable than the present.

Another way in which some of the roads are endeavoring to relieve the labor stringency is by contracting such work as can be done by contract to small contractors. By this method the responsibility for securing men is distributed. The Michigan Central has contracted the renewal of ties, the laying of rail and the placing of ballast for several years, and other roads have adopted similar methods. With proper and ample supervision this plan has merit, particularly under existing conditions, and it deserves careful consideration, especially where it is impossible to maintain sufficient forces on a day basis.

While most of the practices referred to above have been established or approved by the railway managements and are, therefore, standard over the system, the local supervisors and foremen also have a very direct responsibility for the conservation of labor. In many ways the problem is theirs more directly than that of the higher officers. They are the men on the ground who come in direct contact with the laborers and should, therefore, realize the detrimental effects of obsolete practices. They owe it to the managements to call attention to the practices which handicap a railway in the efficient conduct of its work and to offer constructive suggestions for the improvement of working and living conditions.

One opportunity which those directly in charge of work have to aid in the solution of the present labor problem is that of impressing on the men the importance of their work for the railways to the national welfare at present. If the fact is brought to the attention of the men that they are performing just as important service to their country by remaining at work on the railways as if they were employed in munition factories, or even were in the army, much can be accomplished. Furthermore, although it is not to be expected that all strikes and labor disturbances can be avoided, the supervisors and foremen directly in contact with the men can do much to allay dissatisfaction by exercising more than the usual amount of tact in dealing with them.

Many improvements in camp equipment which will add to the comfort of the men and increase their satisfaction with their work can be provided at small expense. Unless the intiative is taken by the division officers in matters of this kind the managements can do little. In no way can the division engineer, the supervisor and the foreman serve their country and their employers better at the present time than by so handling their men, whether in large forces or in section gangs, that the greatest possible amount of productive work will be secured with the forces at hand.

Labor Saving Equipment

The greatest opportunity for the conservation of labor lies in the development and use of labor saving equipment. The maintenance of way department has been particularly extravagant in the use of men, prompted largely by the abundance of labor ordinarily available. As a result little attention has been given to the development of devices to replace men and little encouragement has been offered to those who were studying this subject. Not only have manufacturers who have developed devices of this character received scant support, but many ideas tending towards the same end have been left undeveloped, awaiting a favorable time for their introduction, although in nearly all cases in which machinery has been developed to do the work of men it has shown economy in operation during normal times. This saving is increased materially under the present unusual conditions. Now almost over night the conditions have so changed that there is a considerable demand for such equipment on the part of the more progressive roads. One railway which has given this subject careful study has expended over $250,000 for labor saving equipment in the maintenance of way department alone during the last two months.

The officers of the maintenance of way department owe it to themselves to utilize to the fullest extent the equipment now developed and also to assist in the development of other devices of this nature. It is only in this way that the greatest success can be secured. It is probable that the next few years will see the very general use of labor saving equipment of all kinds. This will naturally lead to a considerable extent to the employment of skilled mechanics rather than unskilled laborers on track work. If this occurs it will require fewer and higher priced men and will automatically remove some of the most serious handicaps to the conduct of efficient maintenance of way while at the same time reducing its cost.

One of the most valuable labor saving devices already available is the motor car. Many roads have realized its economy for section, bridge and floating gang use, and have equipped their forces universally with it. It is estimated that there are at least 35,000 motor cars in service in the maintenance of way department today, although there is almost an equal number of gangs not so supplied. The economy of the motor car has been demonstrated so thoroughly that there is little need of further evidence, but an order for over 675 cars placed last month by a road which already has over 525 in service is indicative of the advantages of such cars. A number of roads, such as the Lehigh Valley and the Chicago & North Western, have equipped all their gangs with them.

Another class of equipment for which there is a wide field in this department is the locomotive crane. It is particularly valuable in handling heavy materials, such as rails, frogs, bridge timbers, etc. The Lehigh Valley has been an extensive user of locomotive cranes, the maintenance of way department having the exclusive use of 14 of the 35 cranes in service on this road a year ago, in addition to 8 light steam derricks and 4 air operated hoists. As an indication of the results secured with this equipment, one work train with several machines, each provided with an operator, a fireman and four men, loaded 196,466 lin. ft., or 14.15 track miles, of 90-lb. rails and fastenings in one day at a cost of 15.6 cents per ton. Locomotive cranes are also frequently employed on this road to lower the rails in place during relaying operations, and to assist in renewing bridge ties and other work requiring the handling of heavy materials.

An important development of the last few years is the rail-laying machine. With the 90-lb. and 100-lb. sections now commonly used, from 15 to 20 men are required on the tongs. Machines have been developed and are now on the market which, with four or five men, will not only do the work of the 15 or 20, but will do it faster. Similarly, the pneumatic tamping machine has now passed the experimental stage and is enabling ties to be tamped more rapidly and better.

One of the tasks requiring a large amount of labor, particularly on branch lines with inferior ballast, is the weeding of the track. One of the earliest labor saving devices used for this work was the weed burner. Although employed quite extensively a few years ago its use has decreased recently. However, in view of the present shortage of labor this year one western road has already bought a new machine and others are planning to use them more extensively than heretofore.

A more recent development to eliminate hand weeding is the use of chemicals. The mileage of tracks covered in this way has increased rapidly during the last three or four years. The burning and the killing of weeds with chemicals deserve special consideration this year as does also the mowing of those portions of the right of way adjacent to the track with machines attached to and operated by motor cars.

In the conduct of routine maintenance of way work it is frequently necessary to handle considerable quantities of

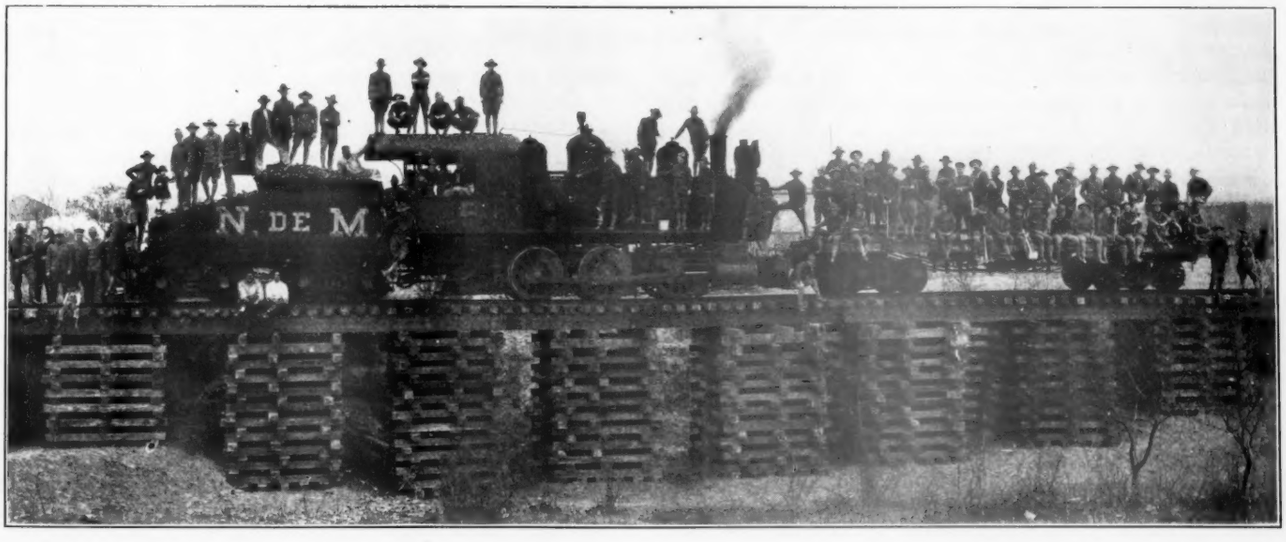
cinders and other materials for use as ballast or for bank widening purposes. The increased use of bottom dump and side dump cars and of spreaders will eliminate much of the shoveling necessary with the old type equipment. The employment of ditching machines is also increasing as the high cost of handling work of this character by hand is becoming more generally realized.

Not all of the opportunities for the reduction in labor follow the substitution of machines for men. Much can also be accomplished by the adoption of measures which will reduce the amount of work to be done. The use of improved joints, rail anchors and tie plates are examples of materials of this kind, reducing as they do the amount of work to be done in surfacing track, straightening ties, maintaining the allowances for rail expansion, re-gaging track, etc. The more general use of such appliances will decrease materially the number of men required for corrective work and aid in the general conservation of labor.

In brief, it is important that no attempt be made to reduce the amount of maintenance of way work done, but that every endeavor be made to maintain the tracks and structures to the highest practicable standards in order that they may be able to meet any demands which the industries or the government may place upon them. The shortage of labor is a natural result of the widespread industrial activity and the war, and little if any relief can be expected from it. The solution of the problem lies in the conservation of the existing supply of labor through the adoption of methods to retain in the service the men now in railway employ, to secure the greatest amount of productive work from them and to supplement and increase the efficiency of their work with labor saving equipment wherever possible.

Photo by Underwood & Underwood

As Soon as an Advance Is Made the British Construction Forces Rush Forward the Construction of Railroads to Carry Guns, Supplies and Ammunition to the Front



Copyright by E. Moore, Laredo, Tex.

A Section of Track Constructed by the Third Battalion of the Fourth Missouri Infantry Near Laredo, Tex., in November, 1916, for Training in Case the Troops Were Ordered to Cross the Border

CLEARANCE RECORDS ESSENTIAL TO MILITARY OPERATIONS

One of the most important problems that will confront railway and government officers in the operation of American railways during the war is that of choosing routes. On its proper solution will depend the efficient movement of troops, munitions and supplies, and while there are many other phases of the question to be considered, a complete knowledge of the minimum clearances along the different lines is essential. Since the clearances now existing must be accepted as they are rather than as they might be desired to be, it is essential that the railroads know exactly what these clearances are in order that the delivery of materials may not be delayed at a critical time. It is also necessary that the operating officers be furnished with complete clearance records from which they can determine accurately and without delay whether heavy ordnance or other government shipments of large or unusual dimensions can be moved over a certain route safely.

While it is true that most roads are making an effort to maintain clearance records which, in the main, are compiled from accurate data, still in many cases the results obtained from their use are unsatisfactory either because of the poor arrangement of the information or the failure to keep the records up to date. Under ordinary conditions, poor arrangement of the data results in delay in arriving at a definite conclusion and often causes loss to the railroad of profitable shipments as well as annoyance to the shipper. Failure to keep the records up to date may lead to acceptance of shipments that will not clear, thus resulting in probable loss of future business through the dissatisfaction of the shipper, in damage to company property, and in possible loss of life to employees. In the first case the time lost is not only that spent in arriving at a definite conclusion as where it is ultimately found that the clearances were ample to the initial time loss must be added the time necessary for making the trip via the second choice route. In the second case other traffic may also be seriously delayed. In both cases the lack of accurate knowledge of the clearances results in the loss of time which it is important to avoid in periods of war.

If delays of this character are to be eliminated in the critical times that may be expected in the near future it is imperative that the railways revise their clearance records at once as it is probable that the special demands that will be made on them will not permit of investigations at a later date. It is particularly important that the records of the railways serving the territory along the eastern and southeastern seaboards be complete in all details, as it is probable that movements of ordnance will be heavier here than elsewhere and this is a district of limited clearances, particularly where tunnels are frequent.

If the most is to be made of the existing railway facilities, it is not enough that the records show the clearances along the main lines of the principal roads. They should also be complete for the relatively unimportant secondary and branch lines as well. Only by having complete information regarding all lines will the operating officers be enabled to route shipments without making unnecessarily long detours.

In routing an unusually large shipment between two points it often happens that the clearances on the line or lines that are the most direct are not sufficient because of the obstructions offered by existing bridges with insufficient headroom or by tunnels built years ago which, like the tunnel that the Pennsylvania is now enlarging on its Philadelphia, Baltimore & Washington line at Baltimore, Md., have become inadequate in vertical and cross clearances. Such a condition necessitates a detour by a less direct route and a complete knowledge of all possible routes is essential if the best line is to be chosen.

In brief, in order that they may be of the most value, the records should not only be accurate but the information should be so arranged that it may be used easily. They should show the clearances on particular portions of the line as between junction points with branch lines or with other roads, as well as for the entire line to enable the government officers or railway men to route unusually large shipments by the proper detours with a complete knowledge that the clearances on such detours will permit the movement.

A record that has been used with success consists of an index map of the system with the lines divided into sections bounded by the junction points with branch and foreign lines, a governing clearance diagram for each section, showing the maximum width and height permissible through the particular section, and a tabulated list of all the sections on which is shown the names of the connecting lines and an index indicating the governing clearance diagrams of the various sections. This information is amplified by an additional tabulation of the various sections on which is shown the permissible height of shipments from 1 ft. in width to the maximum width permissible. A table of explanatory notes as to the uses of the information completes the record. All of the information is tabulated on 7½ in. by 15 in. sheets of tracing cloth which are blueprinted and bound in book form for convenient use. Knowing the point at which the shipment is to be received, where it is to leave the line, and its dimensions, the index map shows at a glance which sections of the line are to be traversed. The index in the tabulated list of sections shows the diagrams to be consulted, from which a decision can usually be arrived at. In case of shipments of unusual shape it is necessary to refer to the tabulation showing the permissible heights at the various widths before making a decision.

The data from which the records are made were secured by the engineering department by direct masurements except in tunnels where clearance cars were used. After once securing the information special care is taken to avoid any change or addition which will lessen the clearances. Positive instructions govern the location of new structures or any additions or changes to old ones. The instructions are in the form of maintenance of way standards which show the required clearance of semaphores, water cranes, passenger and freight platforms, etc. In building platforms or buildings adjacent to curved track the standard provides for the allowance to be made for curvature.

A record is also kept of the clearances of all structures overhead or adjoining main or side tracks regardless of whether or not they are limiting. This record includes data on through plate and truss bridges, inter-track fences at suburban stations, overhead wire crossings and other overhead structures, narrow center tracks, and various other structures. In reballasting where the grade is raised, limiting overhead structures are raised accordingly and in instances where their elevation is permanently fixed the grade of the track is not disturbed, the old ballast being dug out and the new applied. Any temporary limiting of height or width is protected by a flagman or bulletin.

To keep the information up-to-date it is necessary to run a clearance car or to adopt some other method which will give the desired information and to take frequent measurements along the line, especially at structures that are limiting, in order to guard against culminative or gradual changes, such as reduced side clearance around curves occasioned by the gradual change in the position of the line through successive linings and reduced vertical clearances at the limiting overhead obstructions brought about through re-ballasting or renewals of rail. Because of the culminative changes it is particularly important that all roads make a check of their clearances now so as to avoid trouble at critical times.

Organization of the Railways for War

Development of Present Relations Between the Railways and the Government Pertaining to War Transportation

THE present organization of the railways for co-ordinating their operations during the war under the direction of the Executive Committee of the American Railway Association Special Committee on National Defense had its nucleus in the Special Committee on Co-operation with the Military Authorities organized by the American Railway Association last summer to extend the co-operation of the railways in the mobilization of the National Guard at the Mexican border, which itself was the result of negotiations between the railways and the War Department, begun even before the European war was thought of.

In May, 1914, following a determination by the War Department to co-ordinate the agencies required for emergency transportation of large bodies of troops and military supplies, a letter from the quartermaster general suggested to the president of the American Railway Association that the association locate an officer in Washington who could advise with the quartermaster corps on the subject. A member of the executive committee was at once designated a sub-committee to pledge the co-operation of the American Railway Association in any practical way, and after a conference an understanding was reached that the American Railway Association would designate a representative to co-operate in all matters relating to the transportation of troops and supplies other than the routing thereof, to be available to put himself at the service of the quartermaster general on the same day he was called for.

It was suggested that the executive committee would be glad to meet in Washington or make any other arrangements. On October 26, 1915, the Secretary of War referred to this discussion and suggested that the American Railway Association establish a committee to whom the War Department could look for information. The executive committee appointed a sub-committee of four to confer with the Secretary of War and later constituted the sub-committee as the Special Committee on Co-operation with the Military Authorities, consisting of Fairfax Harrison, president of the Southern Railway, chairman; R. H. Aishton, now president of the Chicago & North Western; W. G. Besler, president of the Central Railroad of New Jersey, and A. W. Thompson, vice-president of the Baltimore & Ohio. Several conferences were held with the officers of the War Department, and during the progress of these discussions, on June 18, 1916, orders were issued for the mobilization of the militia of the several states. The plan of organization was promptly adopted, by which the American Railway Association designated officials thoroughly conversant with transportation for duty at the mobilization camps and army headquarters, and a bureau was established at Washington for handling the distribution of passenger equipment necessary for the movement of troops and their return. The work of the A. R. A. Committee on Co-operation with the Military Authorities has been described in previous issues of the *Railway Age Gazette* and was carried on in such a way as to elicit highly commendatory expressions from the President of the United States and from the War Department in appreciation of the effectiveness of the railroad co-operation.

How the Railways Have Organized

RAILWAYS were the first industry in America to organize for War.

Railroads' War Board given authority to operate all railways of United States as a single system.

Action by transportation companies was entirely voluntary and inspired by patriotism.

Much constructive work to increase railway capacity already has been done.

Creation of the Railroad War Board

The Special Committee on National Defense of the American Railway Association was created on February 16, in response to a request of Daniel Willard, as chairman of the committee on transportation and communication of the Advisory Commission of the Council of National Defense. The Council of National Defense was created by provisions contained in the military appropriation bill passed by Congress last summer "for the co-ordination of industries and resources for the national security and welfare." The act provided for the establishment of the council, consisting of the Secretaries of War, Navy, Interior, Agriculture, Commerce and Labor, together with an advisory commission to be appointed by the President, consisting of not more than seven persons, each having special knowledge of some industry, public utility or the development of some national resource, or otherwise specially qualified.

The duty of the Council of National Defense, by the terms of the law, was "to supervise and direct investigations and make recommendations to the President and the heads of the executive departments as to the location of railroads with reference to frontier of the United States so as to render possible expeditious concentration of troops and supplies to points of defense; the co-ordination of military, industrial and commercial purposes in the location of extensive highways and branch lines of railroad"; and other matters relating to the concentration and utilization of the resources of the nation. It was also provided that the council might organize subordinate bodies for its assistance in special investigations.

Daniel Willard, president of the Baltimore & Ohio, was appointed by the President as a member of the Advisory Commission, and was designated chairman of a committee on transportation and communication. He was later also made chairman of the Advisory Commission. At Mr. Willard's request, plans for the co-operation of the railways were considered at a special meeting of the Executive Committee of the American Railway Association on February

16, at which the Special Committee on Co-operation with the Military Authorities was enlarged to 18 members and designated as the Special Committee on National Defense. A meeting of this committee was held at Washington on March 1, at which the members were addressed by the Secretary of War and other officers of the War Department and arranged definite plans of action.

All this was before the declaration of war with Germany. On April 11 Mr. Willard called together the executive officers of the principal railways of the country at Washington in response to a resolution of the Council of National Defense, requesting him to call upon the railroads to so organize their business as to lead to the greatest expedition in the movement of freight, and the present plan of organization was agreed upon in accordance with resolutions adopted providing for the operation of the railways as a continental railway system. The Executive Committee, now generally referred to as the Railroad War Board, was created, the Special Committee was enlarged to 28, and divided into six departments corresponding with the military departments of the army. The committee has since been enlarged to 33 members.

The resolutions adopted at the meeting on April 11 are given, and the organization is generally described in the article by Fairfax Harrison, chairman of the committee, which appears elsewhere in this issue. Lists of the members of the special committee and of its various sub-committees, together with a list of representatives at mobilization camps and army headquarters, have been published in recent issues of the *Railway Age Gazette.*

The Special Committee on National Defense, therefore, is a voluntary organization of the railways. The Council of National Defense has various committees and sub-committees which report to it or to members of the Advisory Commission, and the railroad committee is designated as a co-operative committee on railroad transportation. It does not formally report to the Council of National Defense or to the Advisory Commission, but it works in close co-operation with the council through Mr. Willard, who is ex-officio a member of the executive committee, and reports of its activities are communicated to the council. The committee also has close relations with the Interstate Commerce Commission through Commissioner E. E. Clark, who is also an ex-officio member of the Executive Committee.

Summary of the Work That Has Been Done

The Railroad War Board has been in practically continuous session at Washington since April 23. Its principal activities and the circulars issued from time to time by it and by its sub-committee, the Commission on Car Service, have been reported in the *Railway Age Gazette* as they were issued. A summary of some of the principal activities of the committee is as follows:

The executive committee has established permanent headquarters, with the necessary staff of experts and office employees, at the expense of the railways of the United States, at 719 Thirteenth street, Northwest, Washington, D. C.

To avoid so far as possible the depletion of forces necessary for the efficient operation of the railways, the Council of National Defense was requested, on April 23, to define the government policy with regard to the enlistment of machinists or other skilled railway employees.

Following an investigation into the general situation of the country with respect to coal supplies, it was declared an emergency exists which requires that coal be given preference in car supply and movement.

Eastern Department, District Committee

A. W. Thompson

W. G. Besler

A. H. Smith

L. F. Loree, Chairman

W. W. Atterbury

A similar inquiry as to the necessities of the iron and steel industries for supplies of ore for their full operation, upon which in a great measure the successful prosecution of the war depends, and considering particularly the short season of lake navigation upon which a large part of the ore shipment depends, requires in the opinion of the committee that the movement of ore be preferential second only to coal. The necessary instructions to the railways to carry out these preferences were issued.

Western Department, District Committee

E. P. Ripley

William Sproule
Chairman

R. S. Lovett

In view of the necessity for the withdrawal of several tugs from New York Harbor for naval use, the railroads serving that harbor were requested to mobilize the tugs located there, with the view to their fullest possible use for railroad terminal service.

To facilitate the free movement of freight, the car service rules, which restricted the movement of box cars according to ownership, were so modified as to permit a larger latitude in the handling of such cars in the interest of national efficiency as distinguished from that of individual railroads.

Southeastern Department, District Committee

W. A. Winburn

W. J. Harahan
Chairman

R. V. Taylor

E. H. Coapman

At Mr. Willard's request, the committee submitted suggestions to the Council of National Defense as to persons to compose the proposed railroad commission to visit Russia and recommend methods for the operation of the Siberian railroad.

The Advisory Commission of the Council of National Defense was advised that it was the sense of the committee that conventions bringing large bodies of persons to one point should be discouraged in the interest of conservation of fuel, to avoid congestion, to prevent interruption to necessary freight traffic and to conserve equipment and energies which must be applied to accomplish the transportation required by the country. Notice of this view was also imparted to the railways through their passenger associations, and the plan has been approved by the Secretary of War.

The committee has arranged for active study on the part of the department committees of—

(a) Distribution of power as between railroads.

(b) Adjustment of passenger train service in accordance with national requirements.

The committee put out to the railways a bulletin (No. 12), indicating ways in which added efficiency might be obtained by individual roads.

The committee initiated a movement for the pooling of coal of like characteristics at lake ports, in the interest of efficiency and expedition of movement; this, in co-operation with the Committee on Coal Production, F. S. Peabody, chairman, associated with the Advisory Commission of the Council of National Defense. A similar movement as to tidewater coal has been launched.

In response to a statement of the needs of the French railways, the committee is canvassing the country for the material necessary for their rehabilitation, and is promoting the enlistment of the nine Reserve Engineer Regiments, composed of skilled railroad workers, to undertake this work, as well as the operation of the French railways behind the English lines.

Northeastern Department, District Committee

E. J. Pearson

J. H. Hustis
Chairman

H. M. Biscoe

Morris McDonald

The committee has arranged for the movement of coal for naval use from mines in West Virginia to the Pacific coast in box cars instead of in open cars, in order to prevent the uneconomical empty haul of open cars from Pacific coast points to the East.

The committee, through its sub-committee, the Commission on Car Service, has dealt with a vast number of requests for priority in car supply and in movement, and has dealt with each as the necessities of each situation have been developed. These questions have been brought to its attention by agencies of the government, members of Congress and commercial interests.

Through the same sub-committee the relocation of cars, so as to produce the largest measure of transportation, is proceeding.

The committee has also had under way—

(a) Through negotiations with the National Industrial Traffic League, a representative body of shippers, the formation of committees of shippers to co-operate with it.

(b) The simplification of tariffs covering the movement of impedimenta for troops.

(c) The list of available routes between specified points for the use of military authorities.

The committee has perfected, in connection with the proper officers of the army, a complete scheme of co-operation in the movement of troops and supplies of every description.

On the subject of movement of food products the Executive Committee has had many conferences with representatives of the Allies, of the Department of Agriculture and others, and has given practical expedition of such movement in all cases which seemed to require emergency attention.

The committee has adopted a resolution fixing the per diem rate at 75 cents per car per day from December 15, 1916, to March 31, 1917, inclusive, and at 60 cents per car per day from April 1 until September 30, when it will be subject to further adjustment on its merits.

In addition to the sub-committees previously appointed, a sub-committee on express transportation has been formed, composed of D. S. Elliott, vice-president, American Express Company; E. A. Stedman, vice-president and general manager, Wells, Fargo & Co.; J. B. Hockaday, vice-president and general manager, Southern Express Company, and H. E. Huff, vice-president and general manager, Adams Express Company.

How the Railroads Are Organized

The following is the organization of the Special Committee on National Defense:

Executive Committee

Fairfax Harrison, president, Southern, chairman.
Howard Elliott, New York, New Haven & Hartford.
Hale Holden, president, Chicago, Burlington & Quincy.
Julius Kruttschnitt, chairman, Southern Pacific.
Samuel Rea, president, Pennsylvania.
Daniel Willard, chairman, Advisory Commission, ex-officio.
E. E. Clark, Interstate Commerce Commission, ex-officio.

General Committee

Fairfax Harrison, president, Southern, general chairman.
George Hodges, assistant to general chairman.
J. E. Fairbanks, secretary.

Southern Department, District Committee

C. E. Schaff

B. F. Bush

W. B. Scott
Chairman

T. M. Schumacher

NORTHEASTERN DEPARTMENT

J. H. Hustis, receiver, Boston & Maine, chairman.
H. M. Biscoe, vice-president, Boston & Albany.
Morris McDonald, president, Maine Central.
E. J. Pearson, president, New York, New Haven & Hartford.
Howard Elliott, N. Y., N. H. & H., ex-officio.

EASTERN DEPARTMENT

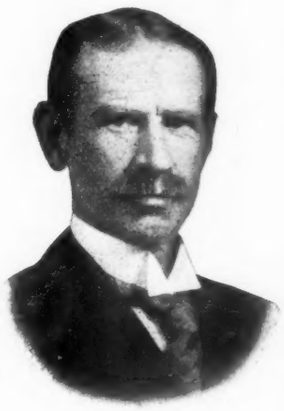
L. F. Loree, president, Delaware & Hudson, chairman.
W. W. Atterbury, vice-president, Pennsylvania.
W. G. Besler, president, Central R. R. of New Jersey.
A. H. Smith, president, New York Central.
A. W. Thompson, vice-president, Baltimore & Ohio.
Samuel Rea, president, Pennsylvania, ex-officio.

SOUTHEASTERN DEPARTMENT

W. J. Harahan, president, Seaboard Air Line, chairman.
E. H. Coapman, vice-president, Southern.

J. J. Fairbanks,
Secretary, General Committee.

Central Department, District Committee



G. L. Peck

E. E. Calvin

C. H. Markham

E. D. Sewall

R. H. Aishton
Chairman

G. T. Slade

J. R. Kenly, president, Atlantic Coast Line.
R. V. Taylor, vice-president, Mobile & Ohio.
W. A. Winburn, president, Central of Georgia.

CENTRAL DEPARTMENT

R. H. Aishton, president, C. & N. W., chairman.
E. E. Calvin, president, Union Pacific.
C. H. Markham, president, Illinois Central.
G. L. Peck, fourth vice-president, Pennsylvania Lines.
E. D. Sewall, vice-president, C. M. & St. P.
G. T. Slade, first vice-president, Northern Pacific.
Hale Holden, president, C. B & Q., ex-officio.

SOUTHERN DEPARTMENT

W. B. Scott, president, Sou. Pac., Tex.-La. Lines, chairman.
B. F. Bush, receiver, Missouri Pacific.
C. E. Schaff, receiver, Missouri, Kansas & Texas.
T. M. Schumacher, president, El Paso & Southwestern.
Julius Kruttschnitt, chairman, Southern Pacific, ex-officio.

WESTERN DEPARTMENT

William Sproule, president, Sou. Pac., Pac. Syst., chairman.
J. D. Farrell, president, O.-W. R. R. & N. Co.
R. S. Lovett, chairman, executive committee, Union Pacific.
E. P. Ripley, president, Atchison, Topeka & Santa Fe.

ELIMINATING USELESS REPORTS

By F. M. Metcalf
Office of First Vice-President, Northern Pacific, St. Paul, Minn.

As an item of economy in normal times the conservation of men by the elimination of unnecessary clerical work on operating department records and correspondence is one which justifies more than a passing thought. As a war time expedient it is especially apropos. While operating officials in general will grant that there is an opportunity in this direction for considerable curtailment, those who have not given the subject detailed study have little conception of the enormous waste of clerical hours alone that prevails on the average railroad in the compilation of non-essential and useless reports and statistics.

On one of the western railroads a representative has just made a canvass of the various reports rendered by division superintendents, master mechanics and storekeepers, and readily determined where a monthly system saving of over 5,000 clerical hours could be made by discontinuing the collection of a lot of excrescent data furnished the management with periodical regularity.

A list was made of over 150 such reports, some taking but a few minutes and others several hours to compile and assemble data therefor. Some of them were nothing but immaterial post-mortem records; some duplicated data furnished on other forms; some included a lot of detail of no particular value, thus permitting liberal abbreviation; while others were required for some special purpose, the object of which had long since been served, though the report was still being rendered regularly because proper authority to discontinue had not been received. All these entailed the keeping of statistics more or less elaborate and the performance of just that much unnecessary clerical labor.

The present average cost of each of these clerical hours is about 36 cents. Thus 5,000 hours cost this railroad $21,600 annually to say nothing of wasted stationery.

Station agents and their forces, particularly at large terminal and important competitive points, are literally swamped with the task of keeping special statistical records in addition to their regular accounts, and of making therefrom with regular frequency and in considerable detail various reports on business out and in.

At one joint station in a western town of less than 20,000 population the agent renders between 55 and 60 such reports monthly. One of them he calls his 7 page report, which takes 59 hours each month to compile. As it is sent to a traffic department head, he had supposed it must be of great value, though in his humble sphere he had never been able to determine its purpose. Recently this report was returned from the office of this traffic official with the endorsement "What is this?", illustrating the futility of the labor involved. The report is still being made.

To detail the various reports concerned in this discussion would make a tedious and useless list. A thorough check and analysis by the head of each department of each report received by his office would soon convince him where some pruning could and should be done. Vice presidents, general managers, general superintendents, mechanical superintendents, chief engineers, superintendents of transportation, general storekeepers, auditors and their various subordinates, as well as the numerous traffic officers would be doing their railroad, and at this time, their country, a genuine service by giving this subject their earnest study and co-operation, as they, as a rule, are the ones who place these burdens upon their employees.

Perhaps no other form of clerical waste on railroads is as great as that originating from the enormous and ridiculous amount of letter writing. As a simple illustration, a prominent officer was complaining recently about his time being so constantly taken up with his voluminous mail that he had no time to give to the study of certain matters which should have his earnest attention. At random, he picked from his desk a file containing 9 letters from which, after scrutiny, he determined that 7 need never have been dictated and typewritten, as a brief endorsement would have served every purpose. He similarly analyzed 6 or 8 other files and concluded they represented about 75 per cent wasted time.

The needless dictating of letters is by no means confined to subordinates, for much of it is done by men whose working time is costing the company as much as 10 cents a minute and the stenographer one cent a minute. This is not where the waste stops for the letter received usually has to be answered, and to do so may require the exchange of several other letters. Thus hour by hour and day by day continues the pressing of a button, the entrance of a stenographer and the constant stream of letters, followed by the attendant recording and filing.

For the purpose of reducing unnecessary railroad telegraphing, various censoring methods have been in vogue for years, but no effective censoring seems to have been applied to the general and more costly wastefulness produced from needlessly long and entirely useless letters, which, to every operating man from the vice-president down, are a bane and hindrance. Seldom does any one of them realize or appear to care how much he himself contributes thereto. Why longer let this abuse escape the censor's corrective process?

The prevailing method of circularizing system or district instructions is needlessly onerous. Much superfluous work could be eliminated if, for instance, instead of a general superintendent sending each of his superintendents a letter directing him to issue certain instructions to employees (which in turn requires them to issue bulletins or circulars), he were to have the instructions mimeographed or printed in circular form and furnish the superintendents in sufficient quantities for distribution purposes. The title of superintendent could be left thereon with the name left blank and stamped in by the local officer when making the distribution. In addition to expediting the issuance of the circular, this method would insure instructions being uniform, and avoid the necessity for the superintendent of each division re-writing them almost simultaneously. Obviously, on a road with a dozen or more operating divisions the annual time saving from the extensive adoption of this practice would reach large proportions.

Doubtless, the Railroads' War Board will shortly undertake the task of determining the extent to which our railways shall go in this matter of records and reports, and will sanction only such as have a definite practical value, thus diverting into channels of real service all present wasteful use of time, money and men. The adoption of a standard list of records and reports by this committee, composed of thoroughly practical railroad men, would prove a boon, as under the present system no two railroads maintain the same records, aside from those required by the I. C. C. classification, and they therefore are the result of the imaginary or real requirements of numerous individual departmental heads or even of their clerks. The employment of a system traveling inspector, thoroughly versed in the details of division clerical work through practical experience, would be of great value in eliminating unnecessary records and in seeing that each clerk understood what he was doing and was doing it with a minimum of labor. He would thus be able to standardize the forces of the various offices and insure uniformity of practices.

Further, were it understood by all concerned that no report could be secured from operating forces except through the general manager by formal application, which would explain to him in detail the necessity for the data, practically all this useless and duplicated work could be circumvented.

Transportation of Military Traffic

Facts Illustrating Volume of Additional Business That Will Be Handled by Railways on Account of War

IN 1916 the railways of the United States handled 22.7 per cent more freight traffic than the average for the preceding five years and in the first months of the present year the volume of their business has been much greater than it was in the corresponding part of 1916. The increase in the demands upon the roads caused directly and indirectly by the European war was already greater than they could promptly accommodate when they were called upon to cope with the new transportation problems thrust upon them by the entrance of our own country into the war.

The nature of the new problems is outlined and some idea is given of the extent of the demands upon the transportation facilities of the country being made and to be made in connection with the mobilization of a great army and of the vast quantities of materials and supplies of all kinds for Army and Navy in the article, which appears elsewhere in this issue, by Fairfax Harrison, chairman of the Railroads' War Board.

Mr. Harrison also shows that the necessity for giving preference to the transportation of troops and materials of war over all other traffic must involve a reduction in the amount of service available for ordinary commercial business unless it is possible greatly to increase the efficiency of the available facilities.

Just how great is the task which the railroads have undertaken, and the extent to which it will interfere with other business depends on so many uncertain factors that they can hardly be estimated at the present time, although there are certain facts which throw some light on the subject. The actual movement of troops is perhaps the simplest part of the work. An enormous volume of transportation must be furnished before there is any considerable army to move, as shown in Mr. Harrison's article. The work of providing and assembling vast quantities of supplies and equipment of all kinds has been under way for some time. The part of the railroads thus far has been largely that of providing for expediting the shipment of raw materials, some of them from unusual sources of supply, creating new currents of traffic, and of organizing for the work that is to come, while promoting in every way possible the movement of food, fuel and other necessities for the people of this country and for our allies.

The work of arranging for the furnishing of cars and for expediting shipments is under the direction of the Commission on Car Service, which has been engaged for several weeks in promoting the movement of raw materials. It has been necessary for the government, and for the Advisory Commission of the Council of National Defense, in placing orders for supplies and equipment, not only to arrange for the furnishing of raw materials, but in some cases even for the machinery for their manufacture, because existing plant facilities of the kind needed were inadequate, and the detail railways with one another and with the government.

How War Directly Increases Traffic

MOVEMENT of troops and supplies will require much service.

Establishment of training camps will involve vast freight movement.

Two billion feet of lumber alone may be used for war purposes in twelve months.

Much difficulty will be caused because of need for giving government traffic preference.

Enormous increases of traffic have occurred in other countries in the War.

Troop Movements

Plants which have heretofore done a very small business have received government contracts which have greatly increased their requirements for transportation service.

Present plans of the War Department are understood to provide for the raising of an army of 2,000,000 men. There have already been some movements of the regular army troops and of members of the National Guard that have been mustered into the federal service and the remainder of the National Guard recruited to war strength, approximately 125,000 men, will be called out in three increments on July 15, July 25 and August 5. The heaviest movement will begin in September, when the first unit of the selective draft army, to the number of 500,000, with a reserve of 125,000, will be called into service. Later the President is authorized to draft an additional 500,000. The members of the National Guard and those selected by draft will be sent to training camps in various parts of the country from which they must later be transported to concentration camps located near the seaboard. The first movements will be from local points into one or more mobilization camps in each state and will be handled by the local roads. The later movements from the state camps to the general training and concentration camps will be handled in co-operation with the War Department under the supervision of a central bureau maintained by the Special Committee on National Defense at Washington, which was organized for the mobilization of the National Guard to the Mexican border last summer.

At the time of the mobilization of the European armies at the beginning of the war it was necessary to suspend practically all other than military traffic for periods of from one to two weeks. In this country, on account of the great area from which the forces will be assembled and the number of possible points of departure for transportation abroad, the movement will naturally be less concentrated. The extent to which it will be necessary to subordinate other traffic to troop movements will depend, therefore, on the number moving at one time and the rate at which the various units are made ready for service and at which it is decided to send them abroad. It will also vary with the location of the railways, with reference to the points of mobilization and concentration, but it appears manifest that practically all

railroads in the country will participate and that all traffic, both freight and passenger, will be more or less affected. The sub-committee on Military Passenger Tariffs, of which E. L. Bevington, chairman of the Transcontinental Passenger Association, is chairman, has been working in cooperation with the War Department for the purpose of working out routes from military posts, commercial centers and mobilization points to points of concentration as a basis for determining preferred or emergency routings to provide for practically all possible movements, and to avoid congestions on crowded lines and at important gateways.

The mobilization of approximately 125,000 troops on the Mexican border last summer was accomplished practically without derangement of other traffic except possibly on some of the terminal roads, although it was done on very short notice and with very little preparation on the part of the railways. This year a much greater number of men will be moving at one time and the volume of other traffic to be accommodated at the same time will be greater, but the troop movement itself will be in various directions. It now appears that the transportation of the 625,000 men selected by draft about September 1 will constitute the largest movement at one time to be planned for in the immediate future, unless it is complicated by movements of troops already trained for overseas service about the same time. It is now understood that members of the National Guard will constitute the first expeditionary force to be sent to France very shortly.

Sub-Committee on Military Freight Tariffs

E. B. Boyd

Lincoln Green
Chairman

L. E. Chalenor

R. H. Countiss

F. A. Leland

C. C. McCain

E. Morris

Equipment Required

Some idea of the adequacy of the equipment of the railroads of the United States for the movement of troops may be obtained from a statement prepared by Lieutenant-Colonel Chauncey B. Baker, of the Quartermaster Corps, United States Army, recently distributed to the railroads. To move one field army of 80,000 men, consisting of three infantry divisions, one cavalry division, and a brigade, technically known as a brigade of field army troops—troops auxiliary to the infantry and cavalry divisions—requires a total of 6,229 cars made up into 366 trains with as many locomotives. These 6,229 cars would be composed of 2,115 passenger, 385 baggage, 1,055 box, 1,899 stock and 775 flat cars. This quantity of equipment represents .7 of 1 per cent of the locomotives owned by American railroads, 4.2 per cent of their passenger cars, and .2 of 1 per cent of their freight equipment.

The men going into training camps will not be in the form of field armies and probably will not immediately require the number of other cars named, but over 16,000 passenger cars alone would be required to move 625,000 men at one time, or nearly one-third of the passenger cars in the country.

Last summer an effort was made to accommodate as many of the National Guard troops as possible with Pullman tourist cars, and practically all were enabled to travel at least part of the way to the border in sleeping cars. There were not enough tourist cars to go around, but many who had traveled for one or two days in day coaches were met en route by tourist cars which had made one trip and were returned part way. The Secretary of War has announced that because of the much larger movement, the soldiers this

year will have to travel in coaches and when the time comes that large armies are being moved it will probably be necessary to use freight cars, as is done in Europe. The subcommittee on Military Equipment Standards has been engaged for some time in preparing plans for converting box, flat and stock cars for use in troop trains.

The mobilization of the National Guard to begin next month will be somewhat comparable to that of last year, but it will be more distributed both as to time and as to roads. It is understood that the plans now contemplate that the guard shall be moved direct from their armories to training camps in the South instead of to mobilization camps first. The railroads will have more time to prepare for it than they had last summer, when the call for the first heavy movement of militia occurred in the fortnight which includes the Fourth of July, the time of the greatest density of passenger travel. The transportation of the first 100,000 troops last summer required 350 trains, including over 3,000 passenger cars, 400 baggage cars, 1,300 box cars, 2,000 stock cars, 800 flat cars, and approximately 4,900 locomotives and crews.

The Guard will be called out as follows:

July 15: New York, Pennsylvania, Ohio, West Virginia, Michigan, Wisconsin, Iowa, North Dakota, South Dakota, Nebraska, Minnesota.

July 25: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware, Maryland, District of Columbia, Virginia, North Carolina, South Carolina, Tennessee, Illinois, Montana, Wyoming, Idaho, Washington, Oregon.

August 5: Indiana, Kentucky, Georgia, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, Texas, Missouri, Kansas, Colorado, New Mexico, Arizona, Utah, California.

Training Camps

In addition to the regular army, the National Guard and the selective draft army, there are now in training 40,000 candidates for appointment in the Officers' Reserve Corps and about 15,000 more are to be sent into camps. There are now in operation 16 officers' training camps, corresponding to the territorial divisions in which the National Army will be raised, and the second series of eight camps will open on August 27. Training camps for the National Army are to be located at numerous points. The southeastern roads will be called upon to handle a large share of the mobilization. It was originally planned to erect 32 divisional cantonments to house the army, with about 22,000 men in each, and each comprising a considerable town, with the necessary buildings and lighting, heating, plumbing and drainage systems. It has since been decided, because of the expense and because of the shortage of labor, material and transportation facilities, to build only 16 cantonments and to shelter the men at the other points, which will be principally in the southeast, in tents. Additional information concerning the location of the army camps will be found in an article on that subject on another page.

Sub-Committee on Military Transportation Accounting

M. P. Blauvelt

A. H. Plant
Chairman

G. R. Martin

C. I. Sturgis

R. A. White

C. B. Seger

Sub-Committee on Military Passenger Tariffs

W. H. Howard

C. L. Hunter

E. L. Bevington
Chairman

F. C. Donald

A vast amount of transportation will be required in connection with these cantonments alone. Each will cover about 1,000 acres and include about 1,000 structures, and it is roughly estimated that each will require from 26,000,000 to 30,000,000 feet of lumber, or 500,000,000 feet in all, or about 120,000 carloads to be moved by August 1, to say nothing of the continuous flow of cars to keep the camps in supplies.

Incidental Transportation

Some idea of the incidental transportation to be required on account of the war may be gained from the fact that it has been estimated that it will take 200,000 cars to carry the material which will enter into the construction of the 3,000,000 tons of government merchant ships, to be ordered by the Emergency Fleet Corporation of the United States Shipping Board. Estimates have been made that these will call for 1,000,000 tons of steel in the next year and approximately 400,000,000 feet of lumber, assuming an output of 250 wooden ships during the first 18 months. No estimate whatever can be made of the number of cars which will be needed to carry the material used in the manufacture of munitions and supplies for the army and navy, and in moving them a second time from the point of manufacture to the shipping point. Contracts for ordnance, ammunition, ships, structural steel and machine tools have been let or are being placed, all of which involve a heavy tonnage of steel and large contracts for uniforms, rifles and other supplies are being awarded. For example, 3,360,000 pairs of shoes have been ordered for the Army and 850,000 pairs for the Navy.

The Lumber Committee of the Advisory Commission of the Council of National Defense has prepared estimates that two billion feet of lumber may be required for purposes directly connected with the war in the next 12 months, including 500,000,000 feet for cantonments, 400,000,000 for shops, 200,000,000 for structures for training camps for the Navy; 120,000,000 for aviation school cantonments at Dayton, Ohio; Detroit, Mich., and Champaign, Ill., and four other points; 6,400,000 feet for 200 Y. M. C. A. buildings at Army and Navy camps; 25,000,000 feet for army wagons; 10,000,000 feet for gunstocks, several million feet for packing boxes and crates for the army and navy, while army cots, tent poles, aeroplanes, automobiles, artillery, cooperage, furniture, docks and piers, trench linings, saddles, mine timbers, tools, railroad construction, and the lumber necessary in building factories, all go to swell the total.

The Navy Department is also carrying through a building program in the improvement and extension of navy yards, training stations, aviation stations, the erection of immense storage warehouses for supplies and munitions, the construction of dry docks, gun-shops, and hundreds of auxiliary buildings, all of which mean increased demands for transportation. Training and concentration camps for nearly 50,000 naval militia and reservists are being provided and will be completed by July.

The amount of transportation involved in the preparations now being made is rapidly increasing the railroads' freight tonnage and requires expedited, preferred service. Still greater expedition will be required when the actual movement of men and munitions abroad begins to assume large proportions. Some shipments for the provision of United States forces abroad have already been made, and General Pershing and staff, and the first transport carrying supplies for our expeditionary forces, arrived in Europe during the first week in June.

Cooperation With the Military Authorities

A complete scheme of cooperation in the movement of troops and supplies of every description has been perfected by the Railroads' War Board in connection with the proper officers of the Army, and many conferences have been held with representatives of the quartermaster's corps, the paymaster general of the Navy, the Shipping Board and the Department of Commerce, to discuss the methods of identifying shipments entitled to preference in car supply and movement. The Sub-Committee on Military Freight Tariffs, of which Lincoln Green, vice-president of the Southern, is chairman, has had many conferences with Colonel Baker for the purpose of bringing about the simplification of tariffs covering the movement of impedimenta for troops and the Sub-Committee on Military Transportation Accounting, of which A. H. Plant, comptroller of the Southern Railway is chairman, has been working on a plan for simplifying the accounting for military traffic by introducing a system of interline billing for government freight. An arrangement governing military passenger tariffs was worked out with the government even before the Mexican mobilization of last summer by a committee of passenger officials of which E. L. Bevington was chairman, constituting practically a contract for simplifying and standardizing military passenger rates, accounting and correspondence and eliminating competitive bidding by railways for such traffic. The rates are published in a special tariff and the government is allowed a horizontal reduction below the competitive net fares.

The extent to which the rendering of expedited service for materials of war will necessitate the placing of embargoes against other traffic will be governed largely, of course, by the degree of organization and system which it will be possible to introduce into the operating methods. It has been suggested by the Railroads' War Board that at terminals

all loaded cars may be sent over one line and the empties sent back over another to promote a freer movement of trains. Another suggestion has been that military shipments might be concentrated on certain lines, leaving parallel lines free for ordinary commercial traffic. Some railroad officers have expressed the opinion that such a plan would be ill-advised and that most roads could handle a large tonnage of munitions and supplies in preferred movements without derangement of ordinary traffic by arranging definite schedules for such movements similar to those on which time freight traffic is now operated. In this way it would be possible to give munitions movements preferred attention and high speed service without interfering seriously with other business. For many of the troop movements it should also be possible to arrange regular schedules in advance if sufficient notice is given of the plans. On the Rock Island lines in Texas last summer troop trains were handled as extra freight, as they did not desire faster schedules than the road's fast freight runs. This made it possible to use freight engines and crews.

In Great Britain since May 1, in consequence of the heavy and increasing pressure upon the railways, it has been necessary to co-ordinate the various routes for the conveyance of merchandise and orders were issued that merchandise would only be accepted for transportation between certain points by selected routes chosen for their directness. The shortest routes were not always the most convenient, but were selected because of their availability for commercial traffic and in order to avoid unnecessary mileage.

Some idea of the way the handling of military traffic in war time absorbs the capacity of the railways abroad is afforded by certain of the details that have been published from time to time in official statements regarding the experiences of the French railways, although the experience of some of those lines which are directly in the war zone is hardly comparable with anything the railways in this country are likely to encounter. The Nord Railway of France, which has a large percentage of its mileage and equipment in enemy hands, last October handled a total of 619,795 loaded cars, or 19,993 a day, of which 70 per cent represented military traffic. With its system diminished by half, the road handled more than its entire system had been called upon to handle in peace times. Traffic at the French ports has been greatly increased.

Instructions for Handling Troop Movements

An outline of the relations to exist between the United States military authorities and representatives of the American Railway Association during the war was recently distributed to the railways. This contained some general instructions for the handling of troop movements explaining the duties of the American Railway Association representatives and defining their responsibility, as follows:

"The American Railway Association representative stationed at department headquarters will receive from the department quartermaster, and those at other points from the camp quartermasters, advices regarding the movements of troops. These will show the time troops will be ready to move; the amounts of railroad equipment for each train, showing number of each class of cars required, other than tourist cars; number of persons to travel; amount of baggage, vehicles, guns, and animals; and all other details

General Agents at Military Headquarters, Transportation Department

D. S. Brigham

R. L. O'Donnel

John G. Rodgers

M. J. Gormley

C. L. Macmanus

necessary to enable railroad officials to act intelligently in assembling and placing necessary equipment for prompt loading and entraining.

"The American Railway Association representative will take such action as may be necessary relative to prompt furnishing of the desired railway equipment. It will be the duty of the American Railway Association representative to communicate to the quartermaster any information that he may receive regarding the status of equipment for moving troops and supplies still in camp. His duties will include expeditious assembling of necessary equipment and arrangements for prompt loading and detraining and return of railway equipment from concentration points.

"The American Railway Association representative will communicate directly with the bureau of the American Railway Association charged with the maintenance of information regarding disposition of equipment, its liberation and return, and all other information relating to railway equipment and movements required by that bureau to complete its records. He must furnish a copy of all such communications to the quartermaster with whom he is acting in cooperation.

"The central bureau established under the direction of the general chairman of the Special Committee on National Defense of the American Railway Association will gather all necessary information regarding equipment needed, and available; arrange for transfer of equipment; expedite return of empties; keep informed as to threatened conditions of congestion; make provision for avoiding it; and assist in whatever way is practicable in the smooth operation of troop trains.

"The routing of troops from home stations to mobilization camps will be in the hands of the quartermaster general of the army. Routing schedules will be furnished promptly by, or through, the department quartermaster to the camp quartermaster, showing the route to be used by each organization from the mobilization camp to concentration point or other destinations. Where movements are entirely within the territory of the department, routings will be in the hands of the department quartermaster. Owing to the limited amount of tourist equipment, the assignment and distribution of tourist equipment will be in the hands of the office of the quartermaster general.

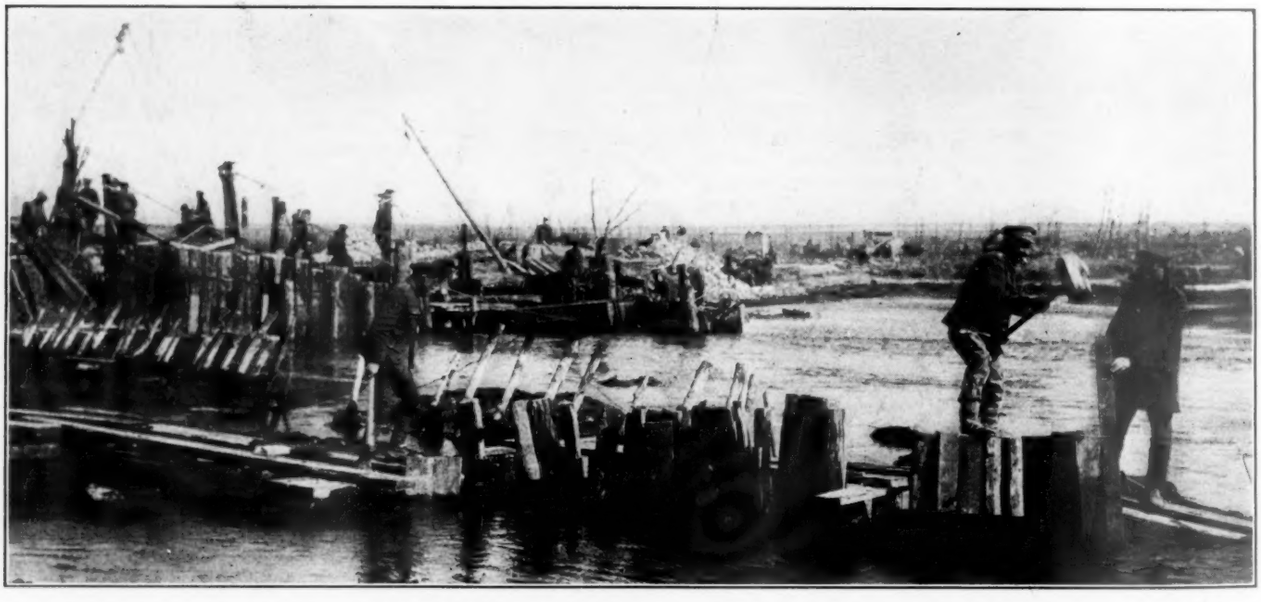
"Camp quartermasters will make direct requests on the quartermaster general for equipment as far in advance as possible, when it is definitely known troops are ready to move, giving name of organizations, number of officers and men to move, route and approximate time of departure.

"The American Railway Association representatives at each camp will telegraph daily to the American Railway Association committee central bureau at Washington, departures for the preceding 24 hours, organizations (with strength) to move in next 24 hours, and strength still in camp, with such other information as may be necessary for their records. The camp quartermaster will assist the American Railway Association representative in securing this information.

"As soon as the railway equipment is received the American Railway Association representative, or some competent person designated by him, will make a preliminary inspection of the same with a view to ascertaining immediately and correcting any defect. If necessary he will at once reject any unsuitable equipment and secure other equipment in its place. Before the troops are entrained a joint inspection of the equipment should be made by the American Railway Association representative and the train commander, or his representative.

"The camp quartermaster, after consultation with the train commander, should advise the American Railway Association representative as to the exact make-up of each train, showing the order in which the cars should be placed in the train. Trains should go through to destination intact, unless there is some exceptionally good reason to the contrary. Under no circumstances will troops be separated from their rations and messing facilities, or animals from their forage and care-takers.

"Particular attention should be paid to the supply of water for drinking purposes. The facilities that are sufficient for normal travel are usually inadequate for troop movements over long distances and a supplementary supply will be provided by placing a barrel of water on the platform of every coach or every second Pullman or tourist car."



British Royal Engineers Building a Temporary Foot Bridge Across the Somme

How Railways Have Revolutionized Warfare

Modern Conflicts Would Be Impossible Without Them. How They Have Been Made Use of in Different Wars

GENERAL LAMARQUE in the French Chamber of Deputies said of railways 85 years ago, while they were yet in their earliest infancy, that their strategical use would lead to "a revolution in military science as great as that which had been brought about by the use of gunpowder." They have been so used from almost the earliest stages of their development, and the prophecy has been verified.

"From a military point of view," said von Moltke, the great military leader of Germany, in 1876, "every railway is welcome, and two are still more welcome than one." Later, he said in the Reichstag, in elaborating the thought: "Railways have become, in our time, one of the most essential instruments for the conduct of war." Yet at that time, following shortly upon the period of forced development of railways as military adjuncts in the American Civil War, the Austrian campaign of 1866 and the Franco-Prussian struggle of 1870-71, railways had only begun to demonstrate their possibilities as the "essential instrument," which they then appeared to von Moltke to be.

While the outcome of the Franco-Prussian war turned largely upon the relative superiority and inferiority of the means of communication in the two countries involved, and the Russo-Japanese war demonstrated the helplessness of a giant without legs, it remained for the present world war to demonstrate the efficiency of this essential instrument in a state of high development and in the possession of each of the contending forces.

If the carrying on of war be considered as a science, it may be said that the instruments of its application have developed more in the last half century than in all the preceding ages of man's existence on earth. More concretely and intelligibly stated, the art of war has developed to a greater extent since the beginning of the American Civil War than in the other 23 centuries since the younger Cyrus made his famous expedition against his brother Artaxerxes, king of Persia, in the year 401 B. C. What was in von Moltke's time one of the most essential instruments has become the instrument without which warfare on the scale on which it is now conducted would not be possible. This statement does not ignore the invention of gunpowder in the twelfth or fourteenth century, nor its common use in Europe since the sixteenth century. It takes into account particularly the changes that have taken place in recent years in armament for the use of gunpowder. It takes into account also that the effective range of a projectile propelled by gunpowder is limited to a few miles, and that the cumulative effect of many guns depends upon the number of men in position to use them. The concentration of men in overwhelming numbers and of armament in inexhaustible quantities for the use of gunpowder and its modern titanic substitutes can, so far as inland transportation has yet advanced, be accomplished only by means of railways. The numbers of men, the use of heavy guns, the quantity of arms and munitions, the extent of territory from which they may be drawn and the length of time through which the wastage of either men or munitions may be kept up, depend largely upon the completeness of the system of transportation and the resources of the territory behind the fighting line. Rail transportation is, moreover, the most effective instrument by which some of the horrors of war are mitigated.

The most significant demonstration of the importance of railways in war was in this country's war between the States. That contest in an incomplete and tentative way demonstrated the effectiveness of the railway for most of the purposes to which it has been put, though on an exaggerated scale, in the present gigantic conflict. A war like the present could never have been conceived except in reliance upon a perfected system of railway transportation. Its purposes can be defeated only by a similarly efficient transportation system backed by superior resources.

Whether any of the great military leaders of history would have accomplished results as far-reaching either in space or in time as were those actually accomplished had they been in possession of modern means of transportation, it is perhaps idle to speculate. Whether Cyrus, with his 10,000 Greeks, would have defeated the Asiatic hosts of Artaxerxes at Cunaxa, had either possessed other than primitive means of transportation, cannot be known. It is certain that it would not have required a year of time in the performance, nor seven books of the "Anabasis" to cover the incidents of the march over the 300 miles between Sardis and Cunaxa and the return of his victorious army of 10,000 to the sea.

What has been said of the importance of railways as an instrumentality of war, and what follows regarding their indispensability in modern warfare are far from being arguments in favor of the militarization of railways except as a measure of defense. As was said a year ago in an address by W. L. Park, vice-president of the Illinois Central: "Ability to defend one's self from aggression, whether as an individual or as a nation, is far from implying a desire to exploit that ability * * * What the enlightened thought of the people has determined to be essential is that the country should seek to secure itself in such position that if emergency arises it shall not be subjected to immediate defeat. * * * An army, though great as patriotism or conscription can make it and capable as years

Modern War and Railways

RAILWAYS have caused the greatest revolution in war methods since the invention of gunpowder.

The first effective use of railways for military purposes was made in the American Civil War.

The operators of the present war have caused prodigies to be performed by European railways.

There has been interesting experience with railways in the Franco-Prussian, the Russo-Japanese, and all other large modern conflicts.

of training can produce, is utterly impotent without proper transportation facilities for its units and for its supplies. The efficiency of a navy, though it were to outnumber the floating equipment of any other nation, is dependent upon a series of naval bases adequately maintained as to supplies. * * * The real dependence of this country in the event of difficulty with any other nation is based upon its transportation system."

Mr. Park was speaking of preparedness, before the event. The emergency has arisen. The difficulty with another nation has been formally recognized. The nation is at war. Our part in the war is no less defensive in that it begins on foreign soil where other nations have been forced to meet the challenge first. The cause is that of humanity. In the preparation of an army and a navy worthy of a great nation and of the righteousness of the cause, the importance of the third arm of the service must not be overlooked.

Transport of Troops

Obviously the first considerable demand upon the capacity and efficiency of the railway system is for the transport of troops to the point of probable action. Though this is but a fraction of the service railways are called upon to perform, the amount of equipment and trackage required is not generally known. Figures furnished by the War Department show that for the transportation of a single infantry regiment 85 cars of various kinds are necessary; for a cavalry regiment, 150 cars; for a light artillery regiment, 170 cars; for a regiment of horse artillery, 194 cars; for a mountain artillery regiment, 124 cars; and for engineers and signal corps, 66 cars. A single infantry division of three brigades of infantry, one regiment of cavalry, one brigade of light artillery, with the necessary engineer and signal corps and wagon train, requires 1,500 cars; a cavalry division, 1,300. The trackage necessary for entraining or detraining these units ranges from one mile for a single regiment to approximately 15 miles for a division.

If only the transportation of troops were involved, it is plain that the movement of the exaggerated armies of the present day would create a demand upon railway facilities hitherto unprecedented. The limit to the number of troops that may be concentrated upon a single action depends almost wholly upon the completeness and freedom from obstruction of the railway system of the locality. The possibilities were early recognized by leading authorities of military nations. The recognition of these possibilities has had a growth almost co-extensive with the development of railways for commercial purposes. Many of the items of this development as well as other data, are brought together in the recent excellent work of E. A. Pratt, an English writer, on "The Rise of Rail Power in War and Conquest."

The first suggestion of the possibilities of the conveyance of troops by rail was in 1830. On the opening of the Liverpool and Manchester Railway a British regiment was conveyed over the line, 34 miles, in two hours. On foot the journey would have required two days. In 1846 a regulation relative to the conveyance of military forces, their baggage and stores, by rail, was issued by the War Office.

In Germany as early as 1833 a proposal was advanced for a railway between Minden and Cologne and the promoter laid special stress upon its value from a military point of view. He calculated the saving in time and in physical strain and argued that with a railway and telegraph on the right bank of the Rhine a crossing by the French would scarcely be possible, since a strong defensive force could be put on the spot before the attempt could be developed. But the proposals were officially condemned as "nonsensical fancies." As late as 1847 a leading military writer of Germany in a pamphlet proved to his own satisfaction that the best organized railway could not carry 10,000 infantry a distance equal to 60 English miles in 24 hours, and that the conveyance of cavalry and artillery by train would be a sheer impossibility.

Railways for military purposes were under consideration in the Chamber of Deputies of France as early as 1833. Said one advocate of their construction: "An army, with all its material, could in a few days be transported from the north to the south, from the east to the west, of France." In 1837 M. Dufaure asked if it was a matter of no account "that they should be able in one night to send troops to all the frontiers of France, from Paris to the banks of the Rhine, from Lyons to the foot of the Alps, with an assurance of their arriving fresh and ready for combat?" In 1842 an advocate of a line from Paris to Strassburg said: "Twenty-four hours will suffice for our neighbors to concentrate on the Rhine the forces of Prussia, Austria and the Confederation, and on the morrow an army of 400,000 men could invade our territory."

The first example of the transport of a large body of troops was in 1846, when the Prussian sixth army corps of 12,000 men, with horses, guns, road vehicles and ammunition was moved upon two lines to Cracow. In 1850 an Austrian army of 75,000 men, 8,000 horses and 1,000 vehicles was moved from Vienna and Hungary to the frontier of Silesia, 150 miles. For various reasons 26 days were consumed in the journey, but the movement of so large a body was considered instructive and furnished the basis for a scheme of strategic railways throughout Austria. In 1851 a division of 14,500 men, 2,000 horses, 48 guns and 464 vehicles was transported 187 miles in two days.

The Italian campaign of 1859 marked actually the more extensive part railways were destined to play, both strategically and tactically. Mr. Pratt quotes a British officer of that period upon this subject, as follows:

> Railways assisted the ordinary means of locomotion hitherto employed by armies. By them thousands of men were carried daily through France to Toulon, Marseilles, or the foot of Mount Cenis; by them troops were hastened up to the very fields of battle; and by them injured men were brought swiftly back to the hospitals, still groaning in the first agony of their wounds. Moreover, the railway cuttings, embankments and bridges presented features of importance equal or superior to the ordinary accidents of the ground, and the possession of which was hotly contested. * * * The first employment of railways in close connection with vast military operations would alone be enough to give a distinction to this campaign in military history.

In this campaign the French railways transported in 86 days 604,000 men and over 129,000 horses, of which numbers 228,000 men and 37,000 horses were sent to Toulon, Marseilles and other points in the southeast. The greatest movement was by the Paris-Lyons-Mediterranean Railway of an average of 8,421 men and 512 horses daily for ten days without interruption to ordinary traffic. The same movement would have taken 60 days of marching.

These movements were of men and horses only. Food and other necessary supplies did not follow with the same celerity. Troops and horses had no food for 24 hours on the day after a defeat of the Austrians, and the retreat of the latter could not be followed.

These examples are significant as marking the beginning of the application of railways to military purposes when they were yet in the early stages of their own development. What was the magnitude of the influence of which this application was the beginning can only be appreciated if it be remembered how small was the difference in methods of warfare between the campaigns of the world-conquering leaders Alexander, Hannibal and Caesar, and those of Napoleon, marking an interval of two thousand years; and how great is the difference in methods of warfare as exemplified by the conduct of the American Civil War and the present conflict, within but little over a half-century.

Alexander's army, with which he began the conquest of the then known world, consisted of 30,000 infantry and 4,000 cavalry. Hannibal made Carthage mistress of a much greater world with an initial army of 90,000 foot, 12,000 horse and 37 elephants—the latter supplying some

of the elements of modern transportation service, but perhaps more effective as prototypes of the modern "tank." Caesar reconquered the world for Rome and doubled its extent with a force hardly larger than that Hannibal had assembled a century and a half before, and by his own account the largest organized force with which he had to contend consisted of 80,000 infantry and 25,000 cavalry. Napoleon's Waterloo, perhaps the greatest single conflict in history in itself as well as in its consequences, numbered but 72,000 French, 67,000 allied British, Dutch and Germans, with 50,000 Prussians under Blücher to wind up the battle and disorganize the retreat. Except for the use of gunpowder and of artillery thereby made possible, with perhaps some allowance for better organization, training and discipline, the conditions attendant upon the battle were not materially distinguishable from those that marked the periods of conquest before the Christian Era. It is true that Napoleon had at his command larger forces in his previous campaigns; but the fate of the largest force he ever collected serves as an illustration for the present purpose. Of the army of 600,000 men with which he entered upon the campaign into Russia and with but one important engagement, in which 20,000 were lost, but 12,000 were left to cross the Niemen after the rigors of a Russian winter and in the absence of any means of transportation for men and supplies except the few horses left as a part of their forces.

The German and French movements of troops at the outbreak of the present war represent the climax of railway service applied to the concentration of troops. The German movement was remarkable chiefly as a demonstration of the efficiency of the railway system and its organization for the purpose then carried out. The machine was ready. Its human factor was fully trained. It needed only the word of command to be set in motion like any other part of the military organization. Eighteen lines were available for the transfer of troops to the French frontier and the interior connections were such that the throwing of 58 army corps to cover that line was but the result of the perfect operation of a thoroughly-built and tested machine. The system had been built up with an eye to military convenience and was admirable from the standpoint of construction and operation. No conflicts of organization were possible, since the system was a part of the military machine. Briefly stated, in its preparations for war Germany had recognized that the railway system must play a fundamental part, all preliminaries were arranged to rest upon this base, and it performed its part in supporting the complicated structure of the campaign.

The service of the French railways in handling troops during the early days of the war was the more remarkable in that it was in the face of a sudden attack, and not except as a possibility the consummation of a long-thought-out plan. Between August 1 and August 20, 1914, no less than 1,800,000 men were taken to the front. Most of these troops were handled three times between point of departure and destination, making an equivalent of the handling of 5,000,000 men in three weeks. About 10,000 trains were kept in almost continuous operation, transferring men from their homes to their regiments, regiments to their army corps and army corps to the front. The brunt of the military transportation fell upon the privately-owned railway companies because of their geographical location. These movements were effected in what might have been a reign of terror following the sacking of Belgium; but the railway system did not fail.

At the entrance of Italy into the war the government had 5,000 locomotives and 160,000 cars. On two lines 120 trains a day were handled during army concentration. Between May 17 and June 22, 1916, they handled 540,000 officers and men, 70,000 animals, 16,000 vehicles and 900 guns.

In the transport of troops, quicker transport is only one consideration. It has been demonstrated that under favorable conditions of good climate, abundant food, easy marches and fair weather, the waste from ordinary causes in a force of 50,000 men on a ten days' march would be between 2,000 and 2,500 men, and the number of worn-out horses would be large. Unfavorable conditions in any one of these respects would increase the percentage greatly. German authorities estimate the falling out at three per cent in cool and dry weather and at six per cent in hot or wet weather. The retreat of Napoleon's army from Moscow was an extreme instance; but it does not stand alone. In his march over the St. Gothard in 1799 Suvoroff lost 10,000 men in 11 days. Rail transportation must be relied upon not only for rapid movement but for complete numbers of men. In the latter respect the results are probably more significant in a retreat than in an advance.

Transport of Munitions

For the transport of munitions there can be no comparison between the railway and any other system of transportation. Artillery, as late as the time of Napoleon or the American Civil War, was not of sufficient caliber or frequency of firing to make the problem of supply a difficult one. It was hauled to and on the field by horses.

The transportation of heavy guns alone is an important factor in the conduct of modern warfare. The factories where they are made and where they must be repaired are necessarily at a distance from the firing line. The new 16-inch gun of the United States is looked upon with special favor by the War Department. It requires a special car for its transportation, and at least until a year ago there was only one car in the country that could carry it. There are only a few cars capable of carrying the smaller sizes of guns. A 12-inch gun weighs 132,000 pounds; a 14-inch, 139,000 pounds; a former model of 16-inch gun weighs 284,000 pounds; and the weight of the latest pattern of 16-inch gun is about 367,000 pounds. There are comparatively few cars in ordinary railway service which have a capacity of 150,000 pounds or over.

The number of times a heavy gun can be fired without relining is limited. This increases the demand upon the transportation service. The larger the gun the shorter the life. It has generally been supposed that the 12-inch gun would not last for more than 75 rounds. Col. B. W. Dunn estimates that the new 16-inch gun may last for 150 or 200 rounds, and that it may be fired as rapidly as one round a minute. In the 1,440 minutes of a 24-hour day, continuous action would require 8 to 10 guns a day to perform the service of one. The replacement of each gun—removing the exhausted gun and placing its substitute—should go on at the rate of one for each two and a half or three hours. For the transport service between each point of action and the distant factory the railway with a provision of special equipment is the only means available. Without the transportation facilities for a supply of guns, the strongest fortification must be short-lived.

General Joffre's saying, "This is a railway war," would be true if the employment of railways were limited to the transportation of artillery alone. It is the first war in which guns of the calibre of the largest naval and coast defense ordnance have been moved from place to place in wholesale quantities. Their movement has been of as great importance as their use *in situ*. It has required quite as much the service of the railway man as that of the military expert. The military man has said where he wants them; the railway man has put them there. The newest type of British gun is mounted on a massive girder structure carried on a series of articulated trucks, and French guns are mounted in a substantially similar manner. Germany's heaviest guns for coast defense purposes have been mounted on platforms carried by heavy steel railway trucks, "strong

enough," as was said by one writer, "to carry a whole house."

Heavy guns are only one item. Machine gun manufactories and small arms and ammunition works, stores of smokeless powder, torpedo and torpedo-boat works, aeroplane factories, and establishments for the production and storing of all the other appliances for offense and defense, are ordinarily not located near the scene of any considerable action. If they are they are likely soon to be put out of service. They may be located at any point within the country at war, or the material may be supplied from a foreign country. In any event, the distance over which they must be transported may average one-half the distance across the country using them. The supply must depend upon the efficiency of the railway service close to the scene of action and in a less degree upon those lines farther distant. The supply must be constant and in enormous quantities.

The prodigal use of ammunition for heavy and light armament, machine guns and the various paraphernalia introduced during the present war that may be classed as ammunition, constitutes of itself a heavy demand upon railway facilities. Most of it must come from hundreds of miles from where its use is required. It is the function of railways to serve as the means of transport. The service must be continuous so long as it may need to exist at all.

Transportation of Supplies

When a world-conquering army consisted of only 50,000 to 100,000 men, the problem of subsistence involved little more than the choice of a favorable location at which supplies could be brought together from the surrounding country. Sometimes such a location could not be reached and the troops perished. Darius, king of Persia, crossing the Bosporus on a bridge of boats, lost 80,000 of his men on the steppes on the other side where there was no means of feeding them. Lack of supplies was the principal cause of the disaster to Napoleon's Russian campaign. "Living on the country" may become precarious because of the destruction of supplies by a retreating enemy. Collecting food from the country on the line of march is apt to be subversive of discipline.

General Sherman said "no army dependent on wagons can operate more than a hundred miles from its base, because the teams going and returning consume the contents of their wagons."

Since the advent of the railway the number of men and the length of time they can be fed at one position, regardless of the character of the surrounding country, depends upon the capacity and freedom of operation of that part of the railway system that performs the service of delivery. Speaking broadly, it has the resources of the country that controls it, and perhaps the resources of a large part of the world behind it.

Any arrangements made for the provision of supplies in any previous war seem insignificant in comparison with the demands of the present. Furnishing merely the necessaries of life to an army of 4,000,000 men on a line 600 miles long by perhaps 20 miles deep, constitutes one of the most complicated problems of the war. It merely touches the trunk of the system to say that this involves the shipment of 25,000 tons of rations daily. The commissary system of France is typical. In France, before the war, in ten railway centers in different sections there were army warehouses for reserve supplies; 91 bread factories, 58 parks for grazing livestock and 32 concentration warehouses. These contained 767,000,000 rations. The whole was merely a nucleus upon which the present system has been built up. The tentacles of the system, both for collection and distribution, are the lines of railway, with the addition that for both purposes the radius of operation has been extended and subdivided by the use of hundreds of thousands of wagons and automobiles. Supplies, whether from the uninvaded departments of France, from its colonies or from other countries, are concentrated at some 20 central stations 50 to 100 miles from the front, where there are extensive freight terminal facilities and connections. Each central station is fourfold, having sections for commissary, artillery, engineering and hospital supplies. Each forwards daily supplies for 50,000 to 100,000 or more men.

The commissary officer forwards daily from one to three trains of supplies, 40 cars, for each army corps per day, to a regulating station nearer the front. Here the trains are broken up and supplies classified and sent on to distributing stations five or ten miles from the front. From this point strings of cars start on the last stage of their journey, dropping off a car here and there according to the orders. From the time these supplies leave the place where they are produced or the ship which has brought them to France, their handling is a railway operation. The military organization is merely consignor and consignee. Though in France the railway equipment and personnel have been taken over as a part of the military organization, this appears to have effected no material change in the system of operation beyond that entailed by the demands of extraordinary traffic, which must take precedence of all others.

Transport of the Wounded

Transportation for the wounded or incapacitated is as important for those still engaged as for the disabled ones themselves. The prompt removal of those disabled by either wounds or disease to more favorable locations is effective in reducing the percentage of fatalities; but in the case of an outbreak of infectious or contagious disease the prompt removal of the sick is essential to the maintenance of efficiency among those who are left.

Transportation of the wounded is based upon two principles: The maintenance of the mobility of the army by relieving the fighting troops quickly of all who have become non-effective; and the rapid removal of the latter to points where the best skill and most favorable conditions for recovery are available. The main reliance must be upon the facilities afforded by the railways. Particularly in the case of the sick, their distribution over a wide area and in small units is effective.

Formerly, so recently as the battle of Waterloo, large numbers of the incapacitated were left upon the field of battle because of the inadequacy of means of transport. In the Crimean War the facilities were most meager and primitive. Contractors' trucks used in bringing in supplies could carry back only those who were able to sit up. In the Italian campaign of 1859, goods or cattle cars with straw on the floor conveyed the most serious cases, and others were taken in third-class carriages. Because they were saved from dying from lack of any attention and escaped the fevers common to hospitals at the front, the benefits of the railway service are said to have been "immense."

Hospital Cars and Trains

In Germany, experiments based on the knowledge gained in the Italian campaign were made with hammocks suspended from the roof of freight cars. They failed because the roofs were not strong enough to support the weight, and the hammocks knocked together with the rocking of the train.

It was only during the Civil War that the hospital train had advanced so far as to have cars with two or three tiers of rough wooden bunks on each side of a central passage; others with an arrangement by which stretcher poles could be hung on rubber rings from pegs in uprights along each side; and another type on which stretchers could be moved in or out on horizontal supports. This car accommodated 51 patients. These intermediate stages led to the fitting up of cars and special trains, which, with certain limitations as to space, were actually hospitals on wheels with medical attendance and nursing and provision for pre-

paring suitable food for 175 or 200 patients. So far as fundamentals are concerned, this is the modern hospital train. In construction, equipment and organization for operation, the improvements that have since taken place are those which have occurred in medical, surgical and nursing science combined with the advance in methods of railway operation.

For many years in Europe experiments proceeded upon the theory that the same equipment used for the bringing in of supplies should be utilized for removing the wounded. In the Franco-Prussian war the German service was well-organized. But the provision of stretchers resting on poles with laminated springs for standards was open to objection from jolting, and because the floor space only was utilized the capacity of a single car was small. During the siege of Paris, special ambulance trains with passenger carriages for the less badly wounded and goods wagons for the severely wounded, were operated from Paris to Berlin, and about 90,000 men were cared for. The trip required six days owing to traffic congestion. The Germans considered that they entered upon the war in 1870 with wonderfully elaborate arrangements for the removal of the wounded.

In the South African war of 1899-1902 hospital trains specially built or adapted, were devoted exclusively to this purpose. Two trains specially constructed were sent out by the Red Cross. Specially equipped cars were placed at convenient points on railways occupied by the British and were handled in a more or less regular "pick-up" service to permanent hospitals. Part of these were fitted with ward bunks and others with iron frames for stretcher supports.

Hospital trains have increased in number and capacity during the present war because the number of men to be handled in them is so far greater than the whole numbers engaged in any previous war that the results of single engagements are unique in history.

As An Element of Strategy

Limits to the strategical use of railways seem to exist only in the capacity of the general officers in command to recognize their possibilities, a knowledge of how to turn them to practical account, and the availability of railway facilities at the exact time and place when they can best be utilized.

The Austrian campaign of 1859 appears to have been the first to witness not only a considerable concentration of troops by railway at the beginning of the campaign, but also some important movements of troops during its progress. During a certain attack reinforcements were constantly brought up. A correspondent of the London Times wrote: "Train after train arrived * * * each train disgorging its hundreds of armed men and immediately hastening back for more."

There were numerous occasions during the Civil War when the presence or absence of transportation facilities determined the outcome of a campaign or the magnitude of a victory or defeat.

Lord Roberts in the Boer War moved within three weeks over an imperfectly-repaired single track railway from Modder River to Bloemfontein 20,000 men, 13,590 horses and over 24,000 tons of stores.

Such movements seem small when compared with the movement of 240,000 men from the western to the eastern frontier of Germany, nearly a thousand miles, in four days, with perhaps two days for preparation. But this was done in friendly country with resources collected and plans laid at any time within 40 years. There are available six double-track railways between the two locations. There could be no question of the adequacy of supplies. The eyes of Germany for many years have been alternately upon its eastern and its western frontier and have not failed to observe the desirability of rapid communication between them. For the initial movement in the present war, probably the greatest strategical movement Germany ever attempted, though it failed in its ultimate purpose, Germany had 12 double-track lines for 125 miles east of the Rhine, and 18 double-track bridges crossing it. The entire attacking force of 58 army corps was delivered on its western frontier in 20 hours.

Railways, then, may be considered as furnishing the means of carrying out strategical combinations with a rapidity and on a scale of magnitude impossible without their assistance. Their destruction at a critical moment may be an element of strategy as great as their operation.

Military Railways

By the term military railways is understood means of communication built during the progress of a campaign to serve a temporary purpose purely military. The first was in the Crimea, built to serve the allies between Sebastopol and their base of supplies at Balaklava, a distance of eight miles, as a substitute for the impassable roads. Only two of the eight miles were worked by locomotives. At one period the daily haulage amounted to 700 tons and the line was useful at the close of the campaign in removing the troops.

During the American Civil War there were numerous examples of "surface roads" in which ties and rails were laid on the surface of the ground without grading.

In the Franco-Prussian war the Germans built two military railways, one 22 miles long connecting two existing lines, and the other a 3-mile loop detouring a tunnel blown up by the French. The building of the 22-mile line occupied 4,200 men 48 days, though cuts were only about 3 feet and only one embankment exceeded 5 feet. There were two viaducts and two bridges. The work was so poorly done that one locomotive could haul only four cars and repairs after fall rains required nearly as many men as had been engaged in the construction. It was operated for 26 days.

Russia began the campaign of 1877 against the Turks with only one badly-constructed line through Rumania over which it had been agreed that free passage should be given. This line was not only insufficiently equipped, but its gage did not correspond with the broad gage of Russian railways. The short campaign Russia expected was prolonged by the defense of Plevna, and Russia then undertook the building of new lines for military purposes. Though the 229 miles completed was the greatest length of military line yet constructed, 189 miles of it was on Russian territory. The commercial purposes afterward served by these lines were probably greater than their influence from a military standpoint.

A wholly unique military railway was built by the Russians for the transport of troops across Lake Baikal on the Trans-Siberian railway. Ordinary traffic over this 25-mile section was by ferry in summer and by sledges in winter. At the periods of the year when the ice is too thick for the passage of ferry boats and too thin for sledges, about six weeks of the year, traffic was discontinued. In the winter of the Russo-Japanese war rails on long ties were laid on the ice between February 10 and February 29, and between March 1 and March 26, there were taken across the lake 65 locomotives, 25 passenger coaches and 2,313 freight cars. About 1,000 horses were also transferred on this road, though most of the troops and supplies were taken across by the ordinary means of transportation.

Fundamentals of Organization

Sir Charles Owens, formerly general manager of the London & Southwestern Railway, was asked a few years ago by the Secretary of War, "Do you think in any emergency which might arise in this country the railways would be able to cope with it adequately?" Sir Charles replied, "I will stake my reputation as a railway man that the War

Office could not concentrate men and materials half as fast as the railways could deal with them; but the management of the railways must be left in the hands of railway men."

This answer condenses the whole substance of the organization of railways for military purposes. Their function is that of transportation in war as in peace. It is true that the ideal operation of a railway system may be interrupted by the operations of the enemy; but the efficiency of its service has more often been obstructed by conflicts of authority.

It must be recognized in the first place that railway operation is as much a technical science in itself as are the operations of a military campaign. It cannot be assumed off-hand that a general superintendent of a railway will be fully equipped for the successful carrying out of a military campaign, and, on the other hand, there is no greater reason for supposing that a commanding officer of a division can successfully operate a division of a railway.

Aside from the general knowledge of railway science which the better part of a lifetime is not too long to develop, physical conditions affecting operation vary with different sections of the country and on different sections of the same system. Military requirements that may be undertaken in one section with ease may be difficult or impossible in another. Detail information upon the character of the line and its equipment, the capacity of the track, the locomotives and cars available, the extent of provisions of passing tracks and for loading and unloading, can only be acquired by those having had practical operating experience upon the line in question. A railway system or a section of it is a delicate and complicated piece of machinery, of which an experienced personnel forms an important part.

It has been said with reference to the operation of American railways during the early part of the Civil War that because of conflicting, impossible or improper orders, the military railways utterly failed to furnish transportation to even one-fifth of their capacity. The atmosphere was only cleared by an order from the Secretary of War clearly defining the responsibilities of commanding officers with reference to the railway service, and in which the following paragraph occurred:

> No officer, whatever may be his rank, will interfere with the running of cars, as directed by the superintendent of the road, under penalty of dismissal.

The Prussian system of organization is an evolution from the successes and failures of 1870-71, upon which have been grafted the results of comprehensive studies and experiments carried on assiduously through all the years since. The organization in peace differs from that in war only as a military organization may differ under the same change of conditions. The service under one condition is a drill for what may be required under the other.

The minister of war is the chief representative of the interests of the army in railway matters. The chief of the general staff serves as intermediary between the imperial railway bureau and the minister of war. He gives directions for the use of railways in war time and prescribes advance preparations. The railway section of the great general staff collects and has always available all information as to the railways that may affect the movement of troops and handles the details of military transportation in war time. On the outbreak of hostilities an inspector general is appointed for each field of war, who co-ordinates the two groups of services, and under him a director-general controls all railway service through line commissions, of which there are 21 at various centers of traffic. Each commission consists normally of a staff officer of the active army and a railway officer. Subordinate station commissions carry out orders at particular stations or on sections of the line.

In view of troubles arising in 1870-71 on questions of responsibility and control, and notwithstanding the minuteness with which the system has been worked out, the paramount importance of uninterrupted operation is recognized in paragraphs of the regulations:

> Railways can only fully accomplish their important and difficult task during war if no serious hindrances to their management are created by the conduct of troops.

At the time of the Franco-Prussian war Germany had a successful, if defective, railway organization for military purposes. France had the task of creating one based on the lessons of experience without. It was also based upon Prussian examples, but applied to French conditions and French requirements with the French genius for organization. The principles of its organization were: Unification of control for military purposes; and combination of the military and technical elements in the control. In general, the organization consists of a superior military commission—presided over by the chief of the general staff who is subject to the minister of war—composed of six generals or officers of high rank, three representatives of the ministry of public works and members of line commissions appointed for each of the great railway systems. Each line commission consists of a technical member (in practice, the general manager) and a member of the general staff of the army. These commissions are supposed to keep available information as to all questions that may arise as to military transportation over their lines. Their membership in the superior commission assures co-ordination among the various lines and centralizes all information in that body. Their district executives may consist of as many sub-commissions as may be necessary, with station commissions, consisting of a military officer and the station master at each important center of traffic. On the outbreak of the war all lines must be placed at the service of the state in whole or in part. The lines can be used for ordinary traffic only to the extent approved by the minister of war.

Under this general organization a system of operation in war has been worked out in infinite detail. It differs from the German scheme in obviously having for its *motif* defense rather than aggression. The German organization had certain definite campaigns fully mapped out with sealed orders in the hands of every railway official of a certain rank, which were to be acted upon when the word was given from Berlin. The French organization had provided itself with knowledge and with tentative plans that might be put into operation according to the requirements of any one of a number of possible contingencies. The way in which it withstood the supreme test in the rapid concentration of troops at the beginning of Germany's attack and the regularity with which its complicated elements have operated during the last three years in the face of its enemy in caring for them are a sufficient index of the correctness of its fundamental principle.

In Great Britain's provision for control of its railways in case of war, the government followed closely the general precedent that had been established in the United States during the Civil War. The act of 1871 provided that in case of emergency the government might take over the railways or any portion of their plant and use them as long as the emergency continued. Permanent organization designed to serve as sources of information to the government as to the technical working and traffic facilities of the railways have been in existence in one form or another, as the Engineer and Railway Volunteer Staff Corps, the War Railway Council, etc. The test presented by the Boer war suggested the advisability of supplementing the efficiency of the railways by the creation of a central executive body which would insure co-operation between the government and the railway managements and harmony of action between the various managements. The War Railway Council, which was purely advisory, was succeeded by a Railway Executive Committee, composed of the general managers of the leading railway companies. This committee constituted the executive body for operating the railways on

behalf of the government, receiving the instructions of the government as to military and naval requirements and giving effect to them through the individual companies, each of which retained the management of its own line. This is the organization now in control. It was brought into active operation by an order in council, dated August 4, 1914, as provided in the act. The first notification of the executive committee stated that "the staff on each railway will remain under the same control as heretofore, and will receive their instructions through the same channels as in the past."

Russia's history has shown the comparative powerlessness of an immense army without the assistance of an adequate railway system or organization for its operation. In the Crimean campaign it is said that "the huge columns that had quitted the far north and east of the interior" had dwindled "to a few broken battalions before they came in sight of Sebastopol." Her opponents had sent their forces to the Crimea by sea. In the Japanese war Russia's fighting ground was 5,000 miles from her base of supplies; the connection, a single line of flimsily-built single track, with a 25-mile ferry or ice-track over Lake Baikal. The insignificant forces that could be collected at one time in the east were successively picked off by her opponents as fast as they arrived. As for supplies, Kuropatkin said: "Waterproofs sent in summer arrive when we want fur coats; fur coats come to hand when we want waterproofs." In the present war there was time for the concentration of a considerable force upon the border before its services were actively called for, but adequate supplies for them could not be maintained

The fundamental principles of organization for the operation of railways in war time made apparent during the Civil war in the United States and recognized by Great Britain and even by Prussia, notwithstanding the close relation between its railway system and the military establishment, are evidently those formulated in a few words as the basis of the French organization, viz., (1) Unification of control; and (2), a combination of military and technical railway elements in that control. It is a matter of gratification that these principles have been recognized so fully in the United States in its present emergency. Their recognition is of the greater importance because of the magnitude of the railway system to the operation of which they must be applied.

From the outline that has been given in the foregoing it is apparent that the stupendous part that railways have performed and must perform in the present struggle involves less change in kind of service than in degree of efficiency to perform exaggerated service analogous to those which they perform in time of peace. Railway men rather than military men must be the ones who must be relied upon to meet these demands successfully; and the resources with which they are provided must be as unstinted as are those bestowed upon an army or a navy.

Where the Army Camps Will Be Located

An Enormous Amount of Transportation Required for Building and Maintenance of the Training Camps

THE recent announcement by the Federal government of the location of the sites for the cantonments and camps for the accommodation of the various army groups, is a matter of particular importance to the railways because of the marked influence on the war transportation problem. Each of the 16 cantonments for the National selective conscription army will provide shelter for 32,000 men in wooden buildings; and since these are to be located in open areas where no improvements exist today it means the building of a city for 32,000 inhabitants at each point in a few months. The men also will be moved to and from these points in limited periods of time while large quantities of food and other supplies will be consumed during the course of their occupation. The camps also will probably be visited daily by large numbers of people. In consequence the freight and passenger business to and from these camp cities will be of large proportions from the time that construction commences until the war is over.

Similar conditions to a somewhat lesser degree and for a somewhat shorter period will obtain in the camps to be provided for the mobilization of the militia. As the militia units can be made ready for active service in a much shorter time they will be housed in tent camps until such time as they are sent overseas. The site of 6 of the 16 camps to be used for this purpose have been announced at the time of writing.

The government has also announced the location of the 13 camps for the training of Reserve Officers and candidates for officers' commissions. As these camps are practically all located at permanent army headquarters, where in general the accommodations for the men are already available, and as the number of men involved is much smaller, these camps do not represent a transportation problem of any unusual importance.

As recently announced the cantonments for the selective conscription army are to be located at Ayer, Mass.; Yaphank, L. I.; Wrightstown, N. J.; Annapolis Junction, Md.; Petersburg, Va.; Columbia, S. C.; Atlanta, Ga.; Chillicothe, Ohio; Battle Creek, Mich.; Louisville, Ky.; Rockford, Ill.; Des Moines, Ia.; Little Rock, Ark.; San Antonio, Tex.; Fort Riley, Kans.; and American Lake, Wash.

Ayer, Mass., is 36 miles northwest of Boston on the Fitchburg division of the Boston & Maine, and at the junction with four other lines of the same railroad. Yaphank, L. I., is on the Greenport line of the Long Island Railroad, 60 miles from New York; Wrightstown, N. J., is located about 25 miles east of Philadelphia on the Pennsylvania & Atlantic, a short north and south line extending from Hightstown on the Amboy division of the Pennsylvania Railroad to Pemberton on the Trenton division of the Pennsylvania Railroad; Annapolis Junction, Md., is midway between Washington and Baltimore on the Baltimore & Ohio main line.

Of the southeastern cantonments Petersburg, Va., is 20 miles south of Richmond on the Atlantic Coast Line and the Seaboard Air Line, these roads being crossed at that point by the main line of the Norfolk & Western. Columbia, S. C., has service from the Seaboard Air Line, the Atlantic Coast Line and the Southern. Atlanta, Ga., receives extensive railroad service from seven roads, and Louisville, Ky., is served by the Pennsylvania Lines, the Baltimore & Ohio, the Louisville & Nashville, the Southern and the Illinois Central.

Chillicothe, Ohio, is located half way between Columbus, O., and Portsmouth, on the Norfolk & Western, which is crossed at that point by the Cincinnati-Baltimore line of the Baltimore & Ohio, and the Ironton line of the Cincinnati, Hamilton & Dayton. Battle Creek, Mich., is on the

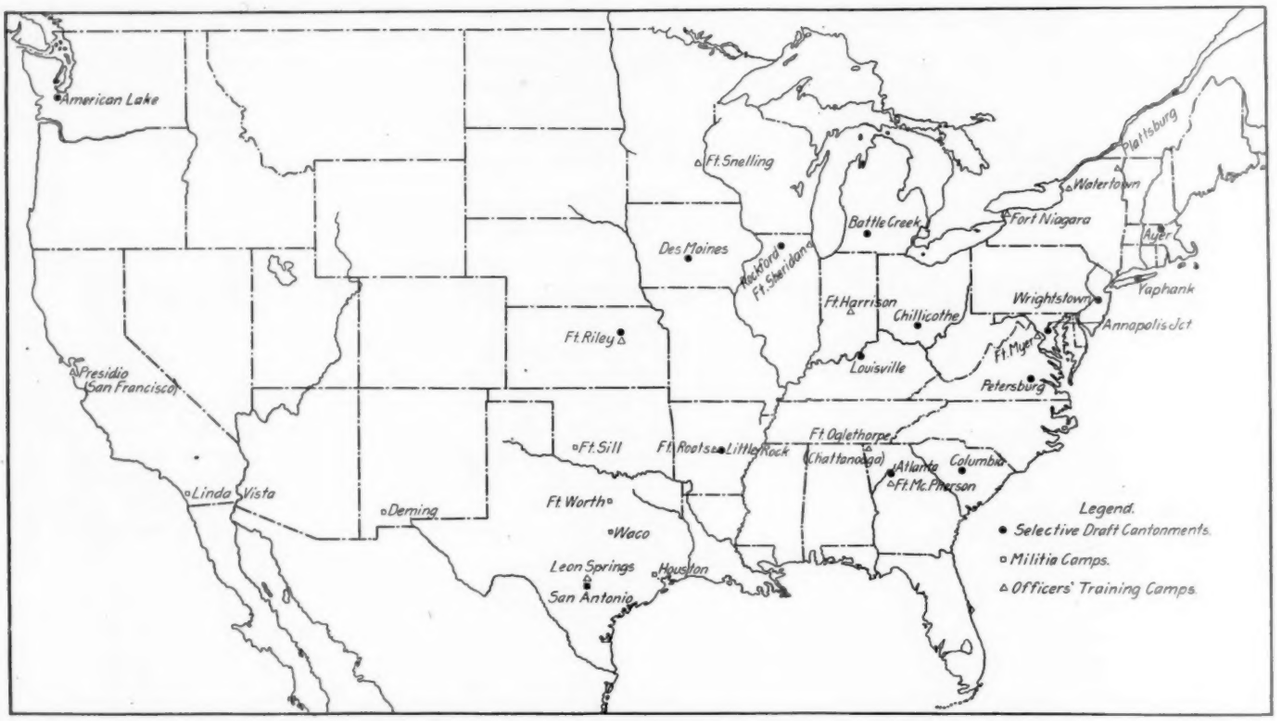
main lines of the Grand Trunk and the Michigan Central, 165 miles northeast of Chicago. Two branches of the Michigan Central also radiate from that point, extending to the southerly portions of the state.

Of the middle western states cantonments, Rockford, Ill., is located on the main Chicago-Omaha line of the Illinois Central, 85 miles northwest of Chicago; it also receives branch line service from the Burlington, the Chicago, Milwaukee & St. Paul and the North Western and is the northern terminus of the Chicago, Milwaukee & Gary, Chicago's outermost belt railway. Des Moines, Ia., is on the Chicago-Omaha and the Kansas City-St. Paul lines of the Rock Island and the Kansas City line of the Chicago Great Western. It also receives branch line service from practically all the other roads operating in the state. Little Rock, Ark., is on the main line of the St. Louis, Iron Mountain & Southern, and the Chicago, Rock Island & Pacific and is the terminus of a branch of the St. Louis-Southwestern. San Antonio, Tex., receives railway service from the International & Great Northern, the Southern Pacific Texas lines, the San Antonio & Aransas Pass, the Missouri, Kansas & Texas and is the northern terminus of the Galveston, Houston & San Antonio. Fort Riley, Kans., is on the Kansas City line of the Union Pacific, 135 miles west of that place. American Lake, Wash., is in the northwestern corner of the country, being 11 miles southwest of Tacoma, on the Gray's Harbor line of the Northern Pacific.

Thus far the location of six of the 16 National guard camps have been announced, all of these being in the southwest, viz.: Ft. Worth, Waco and Houston, Tex.; Deming, N. M.; Fort Sill, Okla.; and Linda Vista, Cal. The first three are well known railroad centers. Deming, N. M., is on the main line of the Southern Pacific, 90 miles northwest of El Paso; it is also on branches of the Santa Fe and the El Paso & Southwestern. Fort Sill is 85 miles southwest of Oklahoma City, on the Frisco and the Rock Island. Linda Vista, Cal., is 15 miles north of San Diego, on the Santa Fe.

The names of the 13 sites for officers' training camps, some of which have been in use for this purpose for some time, are as follows: Watertown, Plattsburgh and Fort Niagara, N. Y.; Fort Myer, Va., opposite Washington, D. C.; Fort Oglethorpe, Ga., near Chattanooga, Tenn.; Fort McPherson, near Atlanta, Ga.; Fort Logan H. Roots, near Little Rock, Ark.; Fort Benjamin Harrison, near Lawrence, Ind.; Fort Sheridan, Ill., on Lake Michigan, north of Chicago; Fort Snelling, Minn., on the Mississippi river south of Minneapolis and west of St. Paul; Fort Riley, Kans.; Leon Springs, Tex., 21 miles northwest of San Antonio; and the Presidio at San Francisco.

THE EUROPEAN RAILWAY MAP.—"Look at the European railway map." Thereon are to be found the real reasons for much of the strategy of this war. For instance, the German-Austrian campaign against Serbia was of enormous importance to the enemy, since its results gave them control of Nish, the railway gateway to the Near East, to Constantinople, and to the whole Bagdad route. And in the Balkans, the control of railway routes is perhaps of even greater advantage than in, say, France or Belgium, because in the near east the ordinary highways are both few in number and unfit for heavy traffic. The importance of the railway as a strategic factor is also exemplified by the case of Salonica, the value of Nish being greatly reduced to the enemy so long as he does not hold the Nish-Salonica Railway as well as the Nish-Constantinople line. Again, recent British advances in the neighborhood of Bagdad, and in the Holy Land, have further discounted the value of the Nish-Constantinople-Bagdad route, both by "bottling up" its terminal section and by driving a wedge between the enemy's eastern lines of communication. And the most casual newspaper reader knows that one of the main reasons why Germany chose 1914 as the date of the war was the knowledge that within three or four years after Russia would have added greatly to her scanty network of strategic railways on the Russo-German frontier.—*Railway Gazette, London.*



Map Showing the Location of the Various Classes of Camps.

Railroad and Industrial Efficiency in War

How to Make the Most Effective Use of Forces and Equipment in the Emergency That Confronts the Nation

By A. L. Humphrey *
Member, Labor Advisory Committee, Council of National Defense.

THE relationship of the railroads to the industrial organizations is a problem which confronts the country in the present crisis of the war in whose maelstrom the United States has been drawn. Our status has been changed from benevolent neutrals to that of active and forceful belligerents. The solution will call for precise co-ordination and effective co-operation of all participating forces. It will also necessitate a radical revision of several time-honored standard practices involving mutual sacrifices and make it necessary to introduce a somewhat new order of things.

When the war broke out, the Canadian railways were the first to respond to the call for assistance on the part of the Imperial Government, by turning their well organized shops into munition manufacturing plants. It soon developed that these railway shops were not as efficiently organized to carry on extensive manufacture on a sufficiently economical basis to enable them to be an important factor in the Government's demands for increased output of ammunition. Canadian railroad conditions in this respect were not unlike those prevailing today in the United States. The organization of our railroads is not sufficiently flexible to permit of the successful manufacture of a new line of product such as this great war has called upon the world's industries to embark in.

A. L. Humphrey

It was soon discovered by the government of Great Britain that the demands were greater than it was possible for the industrial organizations of the Dominion of Canada to carry on, hence the appeal to the industrial organizations of the United States which responded promptly and, time has proven, most successfully. Those who have had experience with our railroads and have been privileged to study the problem from a manufacturing viewpoint as well, will appreciate the lack of flexibility referred to.

Railways Not Successful as Manufacturers

The very nature of railroad organizations prevents the necessary flexibility to insure the successful outcome of such a vast undertaking as many of the American manufacturers were called upon to undertake, the successful performance of which has won the admiration and complimentary mention of the industrial and business world. I believe it can be stated with full truth that no such industrial achievements were ever before accomplished in so limited a period. The success of these undertakings can be attributed largely to the individual authority that was given to the heads of the organizations which undertook the work. It is safe to say that a survey of the successful manufacturing organizations of the United States, which achieved the wonderful results referred to, in every instance, shows some one dominating spirit back of each enterprise, who has been duly delegated without restrictions to organize for the purpose of accomplishing what the corporations had agreed to perform. Full authority in every instance was delegated to the responsible person to spend such sums in creating an organization and in the introduction of heretofore unknown appliances for the purpose of accomplishing unprecedented results and economy. In many instances these industrial organizations spent sums equal to 50 per cent, and in some cases nearly 100 per cent, of their entire capitalization before a single dollar was received in return for products actually completed. Time proved that the confidence which these several boards of directors imposed in the dominating spirit referred to was wise and prudent, and that the money spent for organization and in preparing beforehand was fully warranted.

Under the prevailing system of railroad organization, such a procedure as mentioned would be impossible on account of the well known fact that in many cases, at least, sufficient authority is not given those on whose shoulders the direct responsibility rests for economical operation and maintenance. Instead of preparing for demands upon facilities sure to be made in months to come, expenditures are restricted to meet current earnings with the result that repair shops and repair gangs are disorganized during the very period when roadway and equipment should be receiving most attention, the organization built up, and expenditures made for the introduction of modern machinery and appliances.

The question naturally arises: What can be done to improve the railway and manufacturing conditions of our country during this period of the world's peril? How can the efficiency and usefulness of either or both be increased? It is a well recognized fact that without close co-operation of one the failure of the other is inevitable.

As great as the railroad problem is, the demands upon the industrial resources will undoubtedly prove greater still, and, in order to anywhere nearly meet the demands that will inevitably come, it will require the exercising of supreme authority by some strong individual more far-reaching and more dominating in character than has ever been known in the world's history. A super-strong business man, with broad business experience and powerful business connections, is required to most successfully direct this immense work. The politician, whose chief claim to the place is successful vote getting, should be relieved of responsibility of such important war-time work.

The Labor Problem

There must be the greatest and most effective correlation of all classes of labor, producers, manufacturers, railroads and financiers. This should include a measure of more liberal toleration on the part of both the employer and employees. Antagonism and sharp practice to obtain the greatest possible self-gain must give place to a spirit of greater fairness, resulting in ultimate good to the nation's

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welfare, which is paramount. To this end the strongest of our citizens, regardless of political creed, color, or favor, should be brought to the front to dominate in their special activities. It is time that a halt should be called to the arrogant employer and that the shackles be applied to the labor disturber. There must be a closer unity between employer and the employee. It must be truly recognized that their interests are identical, and, in order to impress upon those interested this fact, conferences between the interested parties must be frequent, at which time differences must be promptly, effectually, and permanently adjusted.

As an appropriate illustration of the tendency of the times in this present crisis, the Labor Advisory Committee of the Council of National Defense is typical. The membership of the Labor Advisory Committee, of which Samuel Gompers is chairman, comprises many of the largest and most experienced employers of labor in the industrial world as well as many of the greatest labor leaders in this country. The purpose of this committee is to promote better understandings between the various elements comprised in our industrial organizations as a group, and so promote national unity. Recently I had the privilege of attending a conference of this committee in Washington and many excellent suggestions were made by representatives of both employers and employed. The only criticism that might have been made was the reference to the "employer" and "organized labor" in the sense of being antagonistic groups, each seeking advantages detrimental to the interests of the other. In the face of the present crisis, such a viewpoint seems strangely inappropriate and out of place; in fact, should belong to a past day. There should be no "employer" during this struggle for national life but Uncle Sam.

There should be no "union" labor in the sense that any man or group of men should undertake to say: "I will do only so much for my country and no more." If a democracy is to be a successful form of government, the principle of universal obligation and service must be fundamental and apply to every man, woman and child. Certainly it is extreme presumption for any man, or class of men, organization or domination, to assume that they carry the welfare of "labor," so-called, in their vest pocket. On the other hand there is no place for the arrogant director of industries, or so-called "employer," who does not show tolerance, kindness, and thoughtfulness for those directly under him.

Training the Unskilled

Women henceforward will necessarily be called upon to a greater extent than heretofore. They must be provided with employment in the field of work for which they are physically and intellectually fit. It is imperative that they be placed on even terms and with equal rights with men, and they should be paid men's wages for performing equal work. Their surroundings should be made cheerful, healthful and sanitary. They should be treated with the same courtesy, chivalry, and gallantry as their more fortunate sisters who are permitted to remain at home; and, speaking from experience, the fact can be stated that there is no way that these requisites can be better accomplished than to provide forewomen to supervise the work that is being carried on by women.

Many skilled workmen are liable to be drawn from the ranks before the conflict ends, necessitating the introduction of the so-called unskilled workman, male or female, in the place of the skilled artisan called to the colors, to perform what has heretofore been recognized as the work of skilled mechanics, thereby creating a scarcity which must be provided for by special training. Past experience, both in this country and in the countries of Europe, has proved that this training can be successfully accomplished by providing schools of instruction, creating a knowledge on the part of the so-called unskilled workmen in one particular specialty.

To illustrate: It is well-known that at the time war broke out there were not a sufficient number of professional toolmakers in this country to meet one-tenth of the requirements. By special provision workmen were placed in the manufacture of some particular piece of apparatus, so that they became equally as skillful in that particular operation as their predecessor who had required years of study and toil to acquire a general knowledge of the art so broad in scope, that, at the best, they could utilize, at any given time, only a very small, limited part of their general knowledge while working upon and preparing some particular piece of apparatus, such as a gage, jig or template that might be required in the manufacture of ammunition. This special training has been much more of a feature with industrial organizations than it has with railroads. Time will prove that next to the training of our soldiers, no feature in connection with this vast problem is going to be more important than the training and preparing of the unskilled but intelligent workmen.

Hours of Labor

Differences of opinion have arisen in plants making ammunition or other war material, both in this country and abroad, with reference to hours of labor. Today, when the destiny of this nation hangs in the balance and free government throughout the world is seriously threatened, contention on this point should disappear with every other restriction upon the efficiency or output capacity of the people. Every right thinking American workingman should resent the attempt on the part of any agency to limit his patriotic contribution by designating the number of hours he should work for the good of his country.

On the other hand, it would be equally dangerous for us to repeat the error made by both the English and French at the beginning of the war when, under pressure of the most urgent necessity and danger, men and women worked such long hours in the factories seven days a week, as to become physically and mentally exhausted. It is imperative that sufficient interval must be provided between working periods for thorough rest and recuperation. If the proper relationship exists between all interested in the cause, whether it be executive, supervising official, or the workman, such a regulation is unnecessary. What results could be expected if the hours of service in the trenches were arbitrarily limited? It would prove a mighty poor consolation to our brave soldiers at the front to be advised that a lack of supplies, including ammunition, had been brought about by the fact that their brothers and sisters at home were by law or fraternal regulation, unwilling to increase output beyond the limit of an eight-hour day, or even a six-hour day as Russia is endeavoring to set up.

If we all work to the same end, without the thought of selfish reward, it is a recognized fact that every provision that could be provided in the best regulated places of employment for the purpose of conserving the health of the workmen (the importance of which cannot be too strongly emphasized) would be provided for through agencies representative of all the people, and not influenced by prejudices or a desire for personal gain. Then, and not until then, may we expect our country to lead in this world's conflict in National efficiency, pride and greatness. Then it will be that every man will recognize that he is a citizen of this great country for service, be that service hard or easy. Therefore, let us strive for perfection in our useful arts and sciences. Let us teach dignity of labor, rights of capital, and the folly of internal dissensions and struggles, which only waste and weaken. Let us teach intelligence and sound judgment to all the people, and then will the Nation realize that the great resources which we possess do not necessarily mean strength, but that only when the whole process of bringing these resources to definite usefulness has been evolved and put into operation, can we expect to achieve the largest possible results.

Increase the Service of Available Power

Dependence Must Be Placed on Existing Locomotives; Careful Maintenance and Supervision Are Essential

THE most important thing to be done to increase the service of the locomotives is for every man in the mechanical department to do his part conscientiously, to work a bit harder and more intensively, to apply more thought to his work, and above all things follow the basic principles of good locomotive maintenance and operation, with no display of excitement or hysteria. In other words, work hard, get down to the fundamentals, and use good plain common sense.

During the past two years the railways have handled an unprecendented amount of business. The demands for power have been very great and the outlook shows no signs of relief. To carry on this war successfully an enormous amount of traffic will have to be handled promptly and safely. This requires adequate power. Unheard of prices are being demanded for new locomotives and still they are purchased, so badly are they needed. In the past when a crisis has arisen in the motive power supply and conditions have been unfavorable to the efficient maintenance of the available power, it has often been possible to save the situation by buying new power. In the present case, with no deliveries possible in less than 11 or 12 months, and the demands incident to supplying a large army to be met during the fall and winter months, no immediate assistance may be expected from this source. It is evident, therefore, that the thorough and efficient maintenance of locomotives and getting the most out of them will be essential to the success of the nation in war.

The part which the mechanical department can play and the results which may be expected therefrom, have been stated concretely by the Railroads' War Board in its suggestion that the number of locomotives under repair be reduced from 15 per cent to 10 per cent, thereby, in effect, increasing the number available for service by over 3,000 for the entire country. This, it may be added, is slightly more than the total number of locomotives ordered by the railroads of the United States during the year 1916. This must be done in the face of a shortage of labor, already acute, which no doubt will grow worse during the coming months, and a material market highly unsatisfactory as to price and delivery. To accomplish this the locomotives must be put through the shops at a more rapid rate and with equally as good workmanship as formerly. In other words, the efficiency of the shop must be increased. A reduction in the number of locomotives in the shops may also be made by equipping them with devices which reduce the time taken to maintain them.

In addition to the saving of power to be made by reducing the percentage of locomotives in the shop, there is a splendid opportunity of increasing the potential ton-miles of the available locomotives by the installation of capacity increasing devices. Also more care must be taken in assigning locomotives to those districts and to the service in which they will produce the best results. In some cases locomotives of suitable size may be released from passenger service for use in freight service by either the reduction in the number of passenger trains or by the release of power from branch line service which has been made possible by placing in service locomotives that were scheduled for retirement.

Improved Locomotive Service

LOCOMOTIVES must be properly maintained and made to deliver the maximum amount of service.

Every effort should be made to keep them on the road as much as possible.

Increase the capacity by improvements to existing units.

Decrease the time the locomotives are held for repairs.

Improve terminal facilities so that locomotives may be turned as rapidly as possible.

Provide ample supervision so that the efficiency of the locomotives and shops may be increased.

Eliminate engine failures.

Above all things follow practices that are fundamentally correct.

Wherever this is done, however, extreme care must be taken in the assignment of the passenger power to freight service so that there will be no interference with the expeditious movement of the freight. Track capacity is a vital factor to be considered, and if the locomotives are not of the proper size the traffic density is liable to be reduced. The released passenger power can undoubtedly be used for double heading with the freight locomotives to increase the train loading. In every case the power should be loaded to the economical limit, hauling the largest amount of tonnage consistent with the desired speed.

To obtain the maximum service from the locomotives the engine crews should be properly instructed and an increase in supervision will unquestionably add materially to the expeditious movement of the trains. The engine failures should be reduced to a minimum.

Locomotive Maintenance

It is of prime importance that the locomotives be properly maintained in order that the maximum service may be obtained from them.

Keeping Locomotives in Service.—There are many ways for increasing the service of the locomotives by the application of devices which will reduce the time the locomotives spend in the shops. The lateral motion limits now set by the locomotive inspection rules of the Interstate Commerce Commission are so small that locomotives must frequently be taken into the shops or at least placed over the drop pit and their wheels removed in order that the lateral may be taken up. In one instance in which the figures are available, the use of removable lateral motion plates has made it possible to keep engines in service for about 150,000 miles without dropping the wheels, the lateral being taken up whenever necessary during the period in which this mileage was made. These engines were also equipped with removable driving box brasses. While no accurate record was kept, over 20 brasses are known to have been renewed on the three locomotives during this period. This would have necessitated the dropping of probably not less than 10 pairs of wheels with the ordinary type of driving box construction, with a loss of not less than two or three days' service of the locomotive in each case.

The uniformly good condition in which automatically adjustable driving box wedges maintain the slack of the boxes in the jaws, has been found to have a material influence on the life of driving box brasses as well as upon the condition of rods and the running gear in general. The result has been that the period between shoppings is lengthened and running repairs are reduced.

Excessive driver flange wear often necessitates the shopping of a locomotive for tire turning. Excessive wear of this kind on one or two pairs of wheels formerly was taken care of by shifting the tires from one pair to another, thus increasing the mileage between turning without taking the locomotive out of service. This practice is no longer permitted under the locomotive inspection rules of the Interstate Commerce Commission as the limits set apply to all drivers. The economic value of the flange oiler as a means of decreasing the rapidity of flange wear, is therefore materially increased. Under conditions where flange wear determines the mileage life of tires, this should not be overlooked.

The quality of boiler feedwater is probably the most important factor in determining the life of locomotive boilers. This is so well known that it is almost axiomatic and yet, considering the country as a whole, the extent to which available means of improving bad water conditions may be put to work, is far from being reached at the present time. Wherever boiler work forms any considerable part of running repairs or is the ruling factor in determining the life of the locomotive, efforts to better water conditions should receive fresh impetus.

These are but a few examples of means of increasing the number of available locomotive-miles by decreasing the time which locomotives must spend in the shop. No doubt other devices or special features for locomotive equipment which have proved useful in this connection, will occur to the reader. It is not the purpose here to catalogue them all. It is the purpose, however, to emphasize the extent to which such means of improving locomotive conditions can be resorted to economically.

Running Repairs—The valves should be kept square and steam leaks by the piston and valve rings should be carefully watched. This is one of the most elusive causes of power losses on a locomotive. It is hard to detect, but expensive in power if allowed to continue. The packing rings should be examined for leaks at least once a month. No engine should be allowed to leave a terminal without assurance of its reaching its destination without failure, for a delay or tie-up on the road under the present conditions greatly interferes with traffic.

The draft appliances on locomotives should be carefully maintained so that the maximum amount of steam will be produced. The ashpan air opening is a matter that is too often neglected. This should not be less than 14 per cent of the grate area for proper combustion. Without sufficient air in the firebox, the coal will not be thoroughly consumed and the capacity of the boiler will be reduced. The ashpan volume should be sufficient to permit the locomotive going from one terminal to the other without it being necessary to dump the ashes from the pan along the road. The firedoor and various appliances about the cab should be maintained in good condition to assist the fireman and engineman in getting the most work out of the locomotive.

The brick arches should be properly maintained. They not only save fuel but permit increased tonnage to be hauled and at higher speeds. The boiler tubes should be kept clean, especially on superheater locomotives, the efficiency of which is dependent almost entirely on the heat passing through the large flues. If these are clogged the effect of the superheater is lost entirely. The tubes should be blown out every trip. Steam leaks in the front end should be carefully watched as they affect seriously the efficiency of the locomotive. The proper size of the nozzle should be carefully determined, it should be made as large as possible and at the same time provide sufficient draft. If a locomotive fails to steam the nozzle should not be restricted; the source of the trouble should be sought and corrected. A restricted nozzle increases the back pressure in the cylinder and reduces the power of the locomotive. Where stokers are used particular care should be taken in maintaining them, for a stoker failure will cause the delay of long trains.

Engineers should be cautioned, especially on pooled engines, to provide proper work reports in sufficient detail to enable the men at the roundhouse to locate the defects so that they may be repaired promptly. Any road that is pushing its power for all it is worth at the present time, in the hope that there will be a reduction in business later, at which time it will be possible to catch up on the repairs, is liable to be placed in a very precarious position. Two years ago after the war broke out, some roads expecting that it would not last long and that the increase in the business of the country was only temporary, they found themselves in a very serious position during the past winter and had extreme difficulty in furnishing proper power and equipment to handle even an average amount of business. The railroads cannot afford to follow such a policy. The power must be maintained.

Back Shop Repairs.—In making classified repairs to locomotives in the general repair shop, the question of facilities plays a most important part in determining the length of time the locomotive is kept out of the hands of the transportation department. Of course, it is out of the question

to make large changes in facilities in all cases where they are badly needed in time to be of material assistance in solving the present difficulties of the motive power department. In many cases, however, there are changes which can be made, the possibilities of which are often overlooked.

The machine tool equipment should be arranged so that it may be used to the best advantage. When new tools are purchased the location of them usually depends upon the available floor space. In such cases the best results can only be obtained by a carefully worked out plan of rearrangement in order that the location of each tool may be in proper relation to an economical routing of the work through the shop. With a growing scarcity of labor, the correction of a poor machine tool arrangement, thereby facilitating the movement of material through the shop, should be carefully considered in the light of conditions which may exist a year or more hence.

A condition frequently met with which limits the output of machine tools below the possibilities of the design of the tool itself, is the lack of sufficient driving power. This is especially frequent in the case of drill presses and is probably more frequent with belt-driven tools than where the tools are direct motor driven. This shortage of power is often due to improper proportioning of the cone and driving pulleys and the use of too light belts. Where machine tool capacity is below the requirements, a careful check of the layout of the power transmission system should be made. The results which may be obtained by comparatively small revisions will amply justify the effort.

The shop demonstrator is a most important factor in securing the maximum output from machine tool equipment, and under the present stress his usefulness will be even greater than heretofore. His services in the instruction of apprentices and the general supervision of machine tool operation are well understood and have been utilized in many shops for years. For the last two years, since the demand for skilled workmen in the manufacture of munitions has greatly increased the turnover of railroad shop employees, many complaints have been heard as to the decreasing efficiency of labor. If the highest efficiency possible under the circumstances is to be obtained from a constantly changing personnel, the closest supervision of shop operation is absolutely necessary. A foreman who is charged with the general supervision of his department, cannot exercise the degree of detail supervision required. Under these conditions the shop demonstrator is absolutely invaluable.

The value of autogenous welding as a part of locomotive repair shop equipment, is so generally understood that little need be said about it here. Its greatest field of usefulness thus far in the back shop has been in the boiler shop. In one large repair shop, where its use has been extended to the exclusion of riveting in firebox construction, the amount of boiler shop work has been so greatly reduced that a large part of the floor space originally assigned to the boiler shop has become available for other use. There are many other shops in which a further utilization of this process will be accompanied by equally marked results.

It not infrequently happens that inefficient machine tools —an old wheel lathe or inadequate planer—are the ruling factors in the shop output. Such conditions, where pronounced, may be readily located, but the difficulty is often with a group of tools which perhaps were built before the advent of high speed cutting steels which are scattered through the shop. Wherever such conditions exist they should be remedied as rapidly as new equipment can be secured. In the erecting shop, facilities for the handling of material and the wheeling and unwheeling of locomotives are of the greatest importance. It is here that labor enters in the largest proportion into the operations performed, and it is highly important that its efficiency be not impaired by delays in the movement of material. In many shops inadequate crane service will materially affect the total output.

Efficiency of facilities is of no greater importance than efficiency of organization in the repair shop. While it is true that any organization must reflect the personal characteristics of the human elements entering into it, the day is past when satisfactory results can be obtained entirely through the energy and personality of the foreman. The locomotive itself has become so complex, and the number handled in the average general repair shop so great, that it is a physical impossibility to secure the best results where the foreman must personally follow up all details of the work as it is distributed through the shop and takes its course from the stripping pit to the erecting floor. Shop scheduling systems have been in successful use for several years and apparently few people have questioned their advantages. Notwithstanding this there is a surprising number of large shops which are operating under the old system. A system of shop scheduling is essential to a smooth flow of work through the various channels of the shop. Without it a well balanced organization is difficult to obtain. Weak points in the shop organization and facilities are brought forcefully to the attention of the shop management by such a system and the importance of correcting them clearly indicated. Friction between departments is reduced and an oversupply or shortage of labor in any department is quickly discovered. The importance of this feature under present conditions is apparent.

A few years ago the reclamation of material began to receive the serious attention of the railroads. Many roads built extensive scrap reclamation plants at their scrap yards and the scope of the work was rapidly extended. In many cases, however, owing to a lack of a proper system of accounting, much material was reclaimed at a cost much greater than the same material could have been secured in the open market, considering the service life of the reclaimed material. The importance of a careful check upon the tendency to overdo this work is just as great now as ever. Overhead costs must be taken into account as well as direct cost. On the other hand, the prices of materials have advanced in some cases several hundred per cent within the last two years, so that notwithstanding the increased cost of labor the scope of the work may be increased to include new classes of materials and by extending the limit to which worn material may be repaired. In many cases material is so difficult to secure at any price that unless reclamation is resorted to, material may not be available at all or the delays in delivery may seriously affect the repairing of equipment.

Owing to a shortage of labor, there has been a deplorable tendency in some shops to become careless in the maintenance of a high standard of sanitary conditions and neatness about the premises. The position of railroad shops has always been weak when the competition for labor is keen. The fact must not be overlooked that the surroundings are no mean factor in securing and holding employees. Under the present conditions, therefore, there should be no relaxation in the efforts to maintain a high standard in the conditions affecting the comfort and personal welfare of shop employees.

It is seldom that the shop capacity is larger than that required to maintain the locomotives under average traffic conditions and with a long period of extraordinarily high locomotive mileage repair shop capacity will undoubtedly be taxed to the utmost. Increased efficiency to meet this condition will be necessary and will materially reduce the percentage of locomotives out of service for repairs. If the shops are to work to the best advantage, it is necessary that a normal balance of light and heavy repairs be maintained, and considerable leeway is therefore necessary in the selection of locomotives for the shops. Careful consideration of this matter, however, especially by closer prediction as to the time each locomotive will require shopping and the ex-

tent of the repairs to be made, will in many cases make possible a material reduction in the length of time locomotives are held out of service awaiting repairs.

The equipment of large engine terminals with drop pit or drop table facilities for wheeling and unwheeling locomotives, making it possible to keep one or two locomotives at the roundhouse for light classified repairs, which require only a few days, may be of material assistance in reducing the time out of service. The necessity of sending the locomotives to the back shop, where they must await their turns, is thus avoided with a reduction of several days in the time actually out of the hands of the transportation department.

The Engine Terminal

Whenever extraordinary demands for power are to be met, the importance of the engine terminal is brought into strong relief. Constant efforts should be made to reduce the time required to pass locomotives through the terminals and again place them at the disposition of the transportation department.

The one point which is more frequently the limiting factor in the output of a locomotive terminal than any other, is the ashpit. This is often due to inadequate facilities for cleaning the pit. Even where the entire installation is inadequate, the cost of facilities for making possible a rapid handling of the locomotives and relieving congestion on the incoming tracks, is comparatively small. At the best, the task of cleaning fires is an arduous and disagreeable one, and although the labor employed at this point is comparatively inexpensive, the necessity for despatch in the performance of the work fully justifies furnishing the best possible facilities at this point. Much may be accomplished in reducing the time on the ashpit and improving boiler conditions by educating the enginemen to bring their locomotives in with a light fire, a full boiler of water and with plenty of steam.

The inspection pit is an adjunct with which many locomotive terminals of importance have not yet been equipped. This permits a more thorough and prompt inspection being made and the work reports are in the hands of the foreman well in advance of the arrival of the locomotive in the engine house. Where only slight repairs or adjustments are necessary, they can be made at the pit, permitting the locomotives being turned without entering the house and thus further reducing the time required in the terminal. The turntable tractor has become a necessity at large terminals where there are a large number of turntable movements.

Hot water boiler washing and filling systems have been extensively applied during the past ten years, but there are still many enginehouses of importance not yet so equipped. These systems possess many advantages over the old method of cold washing and filling, among which may be mentioned reduced boiler maintenance and a material decrease in the amount of coal required for firing up. Under the present conditions, however, probably the most important advantage of such a system is the reduction in time in the roundhouse. This usually amounts to at least two hours. In bad water districts it is often necessary to change the water every trip, and to wash out every other trip or at least once a week. Assuming that the wash-out period is once a week at an engine terminal taking care of 100 engines, the installation of a hot water washing and filling system may be expected to save at least 200 engine-hours per week. The economic value of this saving under present circumstances would be difficult to state in terms of money, but at 10 hours a day, this would be equivalent to 20 engine days.

The necessity of looking after slight defects in locomotives cannot be overestimated. It is often said that the amount of attention required by the more serious defects which develop in the locomotives makes attention to the slight defects or those in the early stages of their development impracticable. However, every effort should be made to correct the small defects before they become serious. Such a policy will not only produce the best results so far as running repairs are concerned, but will postpone the time at which the engine must be shopped for heavy repairs.

Adequate machine tool facilities should be provided at all roundhouses. The use of a more extensive machine tool equipment at small roundhouses is also urgently needed in order properly to comply with the locomotive inspection rules of the Interstate Commerce Commission. There is no doubt but that some of these rules could well be suspended during the war with entire safety, but as long as they are in force and power must be turned without delay, careful consideration should be given to the possibility of increasing facilities at the many small terminals if the best results are to be obtained.

Just as important as shop scheduling in the repair shop, is some system of carefully recording the movement of each locomotive through the engine terminal where more than 40 or 50 locomotives are handled. By such a system each movement may be checked in detail and an obstruction at any point to the steady flow of power through the terminal will be immediately brought to the notice of the foreman.

Under the present conditions, special attention should be given to the problem of maintaining an adequate supply of material at the enginehouse. In the back shop there is usually a limited amount of leeway in the matter of supplying material. In the enginehouse, however, the failure to secure the material needed for running repairs may mean a delay of days to an engine which should have been turned in four or five hours.

Engine Failures

Now, if never before, should the engine failures be reduced to the lowest possible number. An engine failure when the lines are congested means a material increase in the cost of operation and a serious delay to traffic. Careful inspection and proper repairs are, of course, the means by which engine failures may be eliminated. There should be the utmost co-operation between the mechanical department and the transportation department, and no transportation or operating officer should demand power from the mechanical department officer when the latter knows that to allow the power to go out on the road will mean failure and delay. As a means of reducing the engine failures, it is suggested that a careful check be made of all failures in an attempt to place the responsibility for the failure where it belongs. The demand for power should not be held as an excuse for sending an engine out on the road incapable of doing the work for which it is designed.

Nor should the mechanical department be held entirely responsible for the performance of the locomotives. Train despatchers, yardmasters and trainmen all have a hand in the performance of a locomotive. The train despatcher should so despatch his train as to permit the heavily laden locomotive to take advantage of every grade and curve on the division. If a heavy train must be stopped, every effort should be made to have that stop made at the most advantageous place. The yardmaster should not overload the locomotives beyond their rated capacity, but should be sure to see that they are fully loaded. The enginemen should be made to feel the seriousness of the present situation and do everything in their power to get the engines over the road with the least possible delay.

No attempt should be made to force a locomotive beyond its limit of endurance by keeping it in service when it should be placed in the shop for general overhauling and repairs. The power must be *conserved* and not *killed*. Engine failures must be brought to a minimum, for otherwise the end being sought—the movement of freight with despatch—will be defeated.

Supervision

One method of increasing the service to be obtained from a locomotive is to insure that the engine crews handle their power properly and economically. This can only be done by education and supervision. A larger number of engine movements are now being made than ever before. Firemen are being promoted to enginemen and new firemen are being placed in service. It is highly important that they be properly trained to get the utmost efficiency from their engines. An investment well worth while, both from the fuel standpoint and in the prevention of engine failures and increased efficiency of the locomotives, is to provide an ample number of supervisors in the form of road foremen or traveling firemen who will be constantly on the road, training the men to get the utmost power out of their engines. The roads may be short of men, but if one man can by instructing others make nine locomotives do the work of ten, his being taken from his engine and placed on this work will be fully warranted.

Increase Locomotive Capacity

In numerous cases the capacity of some of the motive power can be increased very materially by the application of superheaters, brick arches, stokers, and other devices which improve the efficiency and capacity of the locomotive. Various published tests have shown what is being obtained in service by their use. The use of the superheater has developed rapidly in the past few years. At the present time it is estimated that about 24,000 superheaters are in use on locomotives. About 40,000 locomotives are thus not so equipped. Of these it would be safe to assume that 20,000 could be equipped to advantage. With an increase in capacity of 25 per cent by the addition of a superheater to a locomotive, which is conservative, the application of superheaters to these 20,000 locomotives would be the equivalent of 5,000 locomotives added to the supply of the country. These could be added as the locomotives are put through the shops. With four superheater locomotives doing the work of five using saturated steam, and with new locomotives ranging in price from $75,000 to $100,000, this surely should appear attractive.

There are from 15,000 to 20,000 locomotives at the present time whose capacity can be increased over 10 per cent by the application of the brick arch. If they were so equipped it would provide an increase in the available power equivalent to from 1,500 to 2,000 locomotives. The brick arch can be applied with but little difficulty, requiring perhaps holding a locomotive out of service for but two days. The expense of application is small compared to the additional revenue because of increased hauling power.

The stoker has also been shown to increase the capacity of locomotives which are of such design that the capacity for burning fuel is beyond the ability of the fireman for firing it.

The following extract from a report made by one road to the Committee on Mechanical Stoking of the Traveling Engineers' Association last year brings out this point clearly: "It is a daily occurrence on ———— division for trains hauled by stoker fired locomotives to overtake trains hauled by hand fired locomotives, and to reduce speed on this account. If all the locomotives on the division were equipped with stokers there would at once be a further increase in the speed at which trains are put over the road, and this would be more noticeable at periods when the traffic is heavy and line congested and, therefore, when it is most desirable."

The use of powdered coal, which is being rapidly developed, is another means of obtaining a great amount of work from a locomotive.

The feedwater heater for locomotives is still another method of increasing the efficiency of the locomotive, and of which but little has been published. This is being developed rapidly and tests on an exhaust type of heater have shown that an increased economy of at least 10 per cent may be expected from it. The heater is, in some respects, similar to an efficient marine type of condenser, being composed of a large number of brass tubes, 5/8 in. outside diameter, and about 4 ft. long between headers, and having a total heating surface of 120 sq. ft. Inside these tubes is a special type of agitator which causes a material increase in the rate of heat transfer. The water passes through the inside of the tubes and a part of the exhaust steam from the cylinder, as well as that from the air pump and feedwater pump, surrounds them. A steam driven pump is used for forcing the water through the heater and into the boiler, which will handle about 50 lb. of water per pound of steam.

The following table gives the results of tests made on a modern Mikado locomotive equipped with a superheater and brick arch, showing the temperature rise in the feedwater by heating it with this apparatus:

Test No.	Duration of Test (hrs.)	Speed (m. p. h.)	Boiler pressure (lb.)	Dry Fuel per hr. (lb.)	Water per hr. (lb.)	Water per lb. Dry Fuel.	Temperature rise due to heater.	Fuel per drawbar hp. (lb.)	Thermal Efficiency.
A	2.00	14.5	205.2	2,086	19.160	9.1	156.3	2.5	7.5
B	1.50	14.5	205.9	2,989	29,077	9.7	160.4	2.2	8.5
C	.75	21.7	204.6	4,052	36,828	9.1	164.8	2.3	8.4
D	1.00	21.7	203.9	5,307	46,900	8.8	167.4	2.3	8.2
E	.75	29.0	204.0	9,297	60,709	6.5	170.2	3.5	5.5

In all five tests the gross saving in heat units was over 12 per cent; that is, the difference in heat of the water as it entered the feedwater heater, and as it came out of the heater (this represents the saving in heat) was over 12 per cent of the total heat put into the water from the time it was taken from the tank until it was emitted from the stack in the form of exhaust steam. Allowing two per cent of the total heat for operating the pump, which is conservative, a net saving of 10 per cent remains. This saving is confirmed by comparing these tests with those made on the same locomotive without the heater and under similar operating conditions. The increase in evaporation per pound of dry coal was over 10 per cent in favor of the locomotive provided with the feedwater heater.

These tests have shown that the results to be obtained from feedwater heating are a saving in the fuel per indicated horsepower, an increase in water evaporated per pound of dry coal and an increase in the thermal efficiency of the boiler. The fireman is able to provide the same horsepower with less labor or more horsepower with the same labor than if no feedwater heater was used, and the rate of combustion of the fuel is brought down to a rate at which the fuel can be consumed at the greatest efficiency.

The power reverse gear is a device which has been found of distinct advantage in increasing the service of switching locomotives. The engines can be handled much quicker and a much larger number of cars are switched per locomotive. The pyrometer in superheater locomotives indicates the efficiency at which the boiler is being operated, and by it the condition of a locomotive boiler may be accurately determined.

Conclusions

The locomotives must be made to do more work to meet the extreme demands of the country now at war. Their efficiency can only be increased by the increased effectiveness of the mechanical department and by the judicious expenditure of capital for improvements in their design. The cost of equipment is extremely high and the deliveries are poor. Every piece of equipment should be made to do a little more and every man should consider it his patriotic duty to work harder to increase the efficiency of the equipment that comes under his care. Good hard work and plain common sense with a clear understanding of the conditions to be met is the railroad man's "bit" in this gigantic world war.

Railway Employees Who Join the Colors

Most of the Companies Will Try to Reinstate the Men on Their Return, But a Few Are Paying Part Salaries

THE railways have raised nine railroad engineer regiments. Many of their employees are in the National Guard. A considerable number of others have left railway service to attend the officers' training camps or to enlist in the regular army or navy. What are the railways doing as to their employees who join the colors, and what promises are they making to them as to reinstatement when they return after the Kaiser has received the sound beating he has due him?

The railways have a particular interest in this matter and a problem that is all their own. For one thing, they cannot be too free with their promises for the simple reason that they cannot afford to lose too many men; efficient operation of railways is even more essential in war time than in peace. But reference is directed rather to the matter of promising back former positions. Nearly every railroad has realized that all promises of this kind must be conditional. A man who joins the colors is doing a big thing and deserves every reasonable consideration. But in fairness to his fellow employees and the passengers, he will not expect to be allowed to run a train or to engage in similar work unless he is in absolutely fit condition, physically and mentally. The railroads that have made promises of this kind nearly all make that condition; but, of course, they also promise that if a man returns to duty and is not still fit to do his former work, everything will be done to find as near an equivalent position as possible.

Reinstatement

There are apparently few roads that have not said that they will follow out this plan. But the promises and announcements vary within wide ranges. Some have simply said that as far as possible, they will hold the men's positions open or that when they return they can have their former or equivalent positions, provided, of course, they are physically fit. Among such roads are the Chicago & Alton, the Chicago, Milwaukee & St. Paul, the Lackawanna, the Erie, the Great Northern, the Katy, the Norfolk & Western, the Southern, the Wabash, and the Western Pacific. Several roads speak in terms of "leaves of absence" or of "furlough," among them being the Rock Island, the New Haven, and the Pennsylvania.

Other roads, including the Chesapeake & Ohio, the Burlington and the North Western have issued an announcement reading about as follows: "For the information of employees who may resign to enter military or naval service, it will be understood that while this company cannot agree in advance to indefinitely keep open any positions for such employees, the company will nevertheless endeavor to reinstate former employees, at the termination of their military service, so far as it can consistently with its duty to the government, the public and its general body of employees; and as far as possible their seniority rights shall be protected."

The Atlantic Coast Line will give employees who return to service precedence over all other applicants for employment, and has announced that it will be the desire of the company to reinstate such employees in their former positions, provided they are in such physical condition as to warrant their reemployment.

Others have gone further than these. The Delaware & Hudson, to take a leading example, has announced that under the resolutions adopted by the board of managers provision has been made that all officers, agents and employees who are members of the National Guard, the officers' reserve corps or engineers reserve corps, who have volunteered or have been called or who shall volunteer or be called or drafted for service in the regular army, will be granted indefinite leave of absence during such service with the assurance that special effort will be made to provide employment for them by the company should they so desire as rapidly as possible upon their honorable discharge. And, it has also added, that if any employee who returns for service whose physical condition will not permit of his performing duties in which he was formerly engaged special effort will be made to give him work which his physical condition will permit him to perform. The Delaware & Hudson is also paying part salaries to enlisted employees, but more will be said about that below.

The Boston & Maine and the Big Four have found it advisable to make a distinction between employees who join the engineer regiments and other employees. The former will be granted leave of absence and their seniority rights will be preserved. No such leave or assurance has been given to men who are leaving the railroad for other military service. But, of course, every effort will be made to take the men back at positions as nearly equal to those they leave as possible.

The Santa Fe has made a slightly different distinction—as to the date of enlistment. It has advised that all employees who voluntarily joined the army or navy prior to May 25 will be given their old or equivalent positions, but that as to those who have left since May 25, it feels that conditions are so uncertain that it could not make this promise. It will, however, do its utmost to place satisfactorily any former employee who wishes to again enter the service.

The Louisville & Nashville similarly will guarantee to the men who were in the militia prior to the call for active service (contingent upon their return in physical condition to perform their duties) the same positions that they held or positions paying the same amount of salary. As to men who were not in the National Guard or who have since joined, the company does not undertake to make any such guarantee, but it does assure them of its willingness to give them preference upon their return as circumstances may permit.

In a number of cases roads have emphasized the requirement that the men return to railway service immediately after their discharge from military service. The Santa Fe's promises, for example, are conditional upon the employee reporting immediately on the expiration of military service; if physically unable to do so, as soon as he is able to pass the physical examination prescribed for that branch of the service in which he is to be engaged.

Seniority and Pension Rights

The following roads are among those that have announced that their employees who enter military service will retain their insurance and pension privileges: Boston & Maine (engineer regiment only); Rock Island; Great Northern and the New Haven. On the Santa Fe, a man will retain his pension and insurance privileges, but the time he is absent will be deducted from his total service with the company in figuring benefits. On the Atlantic Coast Line employees who enlist will terminate their membership in the relief department, so far as sickness or accident benefits are concerned, but may retain their membership for death benefits. The Pennsylvania will arrange to conduct welfare work among such of its employees as enlist by endeavoring

to keep in communication with them, thereby providing a means of communication between the employees themselves and their families or dependents.

Most of the roads that have acted on this matter have said that employees who join the colors will retain their seniority rights. Some roads use the expression, "seniority rights shall be protected as far as possible." On the Erie, the time lost while engaged in military service is not to be deducted from the service period. One road has said that "In view of the present uncertainty as to the length of the time absent, it is impracticable to guarantee seniority rights, but employees will be treated as liberally as conditions will permit." On the New Haven the maintenance of pension and seniority rights will be contingent on the employee's returning to service within 60 days after the termination of the war or within 60 days after being mustered out of Federal service.

General Policy

The railroads of this country, it will be seen, are not by any means a unit in this matter of the treatment of their employees who enlist with the colors. Some roads, on the one hand, are very liberal; others have adopted a more cautious attitude, if such it may be called, realizing that the man who runs an engine or assists in its repair is doing a very essential bit of work towards helping the country win this war. The New Haven's announcement touches upon this matter very aptly. A portion of the announcement reads as follows:

> The importance of the railroads as a national arm of defense is becoming more and more apparent each day, as the strain upon the railroads is being increased by the tremendous activity incident to the country's program of preparedness, and this is particularly true with us on account of the munitions industry of the country being largely concentrated along the lines served by this company. Consequently, any loss of men skilled in the handling of our locomotives or trains on account of the acute labor situation will be most severely felt, but we want every employee to feel absolutely free to act as he deems best for his country and himself.

The Texas & Pacific, the Norfolk & Western and the Missouri, Kansas & Texas are among the roads that take the liberal view of actually encouraging enlistments. On the Texas & Pacific, for example, each available opening in the army or other government service for which railroad employees can be utilized to the best advantage is being posted in such a manner that the company's employees will have an opportunity to enlist if they care to do so.

Several roads, on the other hand, which are otherwise offering to reinstate their employees have, nevertheless, felt that they will make a big mistake if they encourage enlistment too strongly.

The following are quotations from statements made by the officers of some of these important roads:

"We feel that the maintenance of a full staff of experienced employees in railway service is as much a matter of military necessity as actual military work."

"The view of this company's management is that organization and service of the railways is the last that should be impaired by the taking of their men for service in the army or navy. Efficient transportation service for the government is most essential during the war, and if the railroads are going to measure up to the requirements in that respect it is necessary that they retain all of their employees who are willing to remain in the service."

"This company has not offered any inducements to its men to enlist, it being our view that skilled transportation men can best serve their country by remaining in transportation service."

"We feel that the employees on our road are as much in the service of the government as if they were enlisted in the service, as the performances required of the road make it imperative that the organization be maintained in its operating and transportation departments, and we consider, as stated, that the men employed in these departments are a part and parcel of the government, and although they do not get the title of Lieutenant, Captain, Major or Colonel, they will be rewarded with the consciousness that they have devoted their energies in a direction that has helped to maintain the government, to the best of their ability."

Other Features

Few roads have gone so far as to post lists of their employees who have joined the colors. Most, however, are keeping a record of all who have done so, and some are publishing lists of the names in the monthly employees' magazines.

A number of roads have announced that "Preference of employment in this company's service will be given to any members of the families of enlisted employees whose names may be furnished to the officer in charge of the proper department."

Payments to Dependents

In England and in Canada when armies had to be raised by volunteering it was quite the thing for all the railways to agree to pay in whole or in part the wages of their employees who joined the colors. In those countries, too, there was no idea that the war would last for years rather than months nor fear that the sums to be paid out would mount up to almost overwhelming amounts. In this country, on the other hand, we are not raising volunteer armies, except to a limited extent; we believe we are going into a long war; most of the enlistments thus far have been of men without dependents; and as a rule the numbers have not been exceedingly large. There is further the fact that Secretary of War Baker has explicitly asked that no employer enter into permanent arrangements until Congress has had time to act upon this matter.

But few roads have announced that they will pay part salaries to those employees who leave to join the colors, including the Delaware & Hudson and the Norfolk & Western, and the Canadian Pacific. The first will pay up to July 17 at least, to all married men and to unmarried men with dependent families, who were members of the National Guard on February 4, 1917, the difference between the pay received from the railroad and that received from the government, and to the other unmarried men who were members of the Guard on February 4 one-half full average pay, or in other words the difference between the amount paid by the government and one-half the pay received from the company. The Norfolk & Western will pay to all men who were in the service prior to April 1, 1917, the difference between their pay with the company and their army pay, for a period of six months, and thereafter as may be determined. The Canadian Pacific has announced that all employees of the road in the United States who volunteer for service overseas will receive six months' pay when they leave for active service. The company also gives them the practical assurance that they will receive their old positions or ones equally good on their return from military service. Men who wait to be drafted, however, will receive no recognition.

The railroads are particularly interested in a report on this matter which was recently made to Secretary of War Baker as chairman of the Council of National Defense by a special committee of the Chamber of Commerce of the United States. This report recommended that the government enact "legislation providing for reasonable separation allowances to be paid to the dependents of the enlisted personnel of the army and navy, basing such compensation on the number of dependents in each family."

The committee, of which F. A. Seiberling, president of the Goodyear Tire & Rubber Company, is chairman, looked into this problem on a suggestion to the National Chamber by Secretary Baker.

In addition to urging the passage of legislation of this kind, it has further suggested that the government official-

ly designate some national organization to raise a general fund by voluntary public subscription and distribute the fund so raised for the alleviation of conditions not adequately met by national or state allowances. This organization would operate in conjunction with representative local bodies.

Pending action of the federal government in the matter and the publication of details of the ultimate plan, employers throughout the country are advised to make only temporary commitments to the dependents of their employees who enlist.

"In view, however, of the business uncertainty which the temporary nature of these commitments creates," says the report, "and in view of the large and confusing number of individual and separate community efforts to raise funds for the anticipated needs of dependent families, all indicating the need for coordinated effort, this committee very respectfully urges prompt action by the government and the speedy publication of the details of the general plan.

"Large employers throughout the country already have taken the initiative, as they did during the period when troops were required for the guardianship of the Mexican border, and have made provision for the care of the dependents of their enlisted employees. It is realized, however, that this cannot continue upon any general scale, particularly in view of the uncertain period of duration of the war, without imposing hardship and embarrassment upon the smaller employers who are in the majority throughout the country. Obviously, business firms and corporations everywhere would be the largest contributors to any national patriotic fund raised for the purpose named."

The Canadian railroads (as noted elsewhere in this issue) and also the roads in Great Britain for many months after the beginning of the war made large payments to their employees who enlisted. The governments similarly have done even greater work along this line. In Great Britain there is a separation allowance for the dependent family. The wife receives a weekly allowance from the government, to which is added a weekly allotment out of her husband's military pay. The government makes an additional allowance for the first child, more for the second, and so on for every other child in the family. These allowances do not do away, however, with the need for relief efforts on the part of public organizations such as the Soldiers' and Sailors' Relief Society, and other associations whose voluntary workers and local committees take care of cases seeming to demand special assistance.

In Canada, there are three sources of revenue for the soldiers' dependents. First, a portion of his pay, the percentage determined by individual conditions, is deducted and sent home. Second, the government makes a separation allowance intended to enable dependents to approximate the pre-enlistment maintenance standard. This allowance is a flat sum, regardless of the size of the family. Third, there is a National Patriotic Fund, raised by voluntary public subscription and distributed by a corporate organization authorized by the Dominion government. This fund takes care of necessitous cases where local investigation seems to establish the need for it. The Canadian railroads have made large contributions to it.

Different Rates of Pay Undesirable

The report of the Chamber of Commerce's Special Committee says that enlisted men in the armies above referred to neither need nor desire remuneration in addition to the service pay which, in accordance with rank, they receive as a provision of statute, for the following reasons:

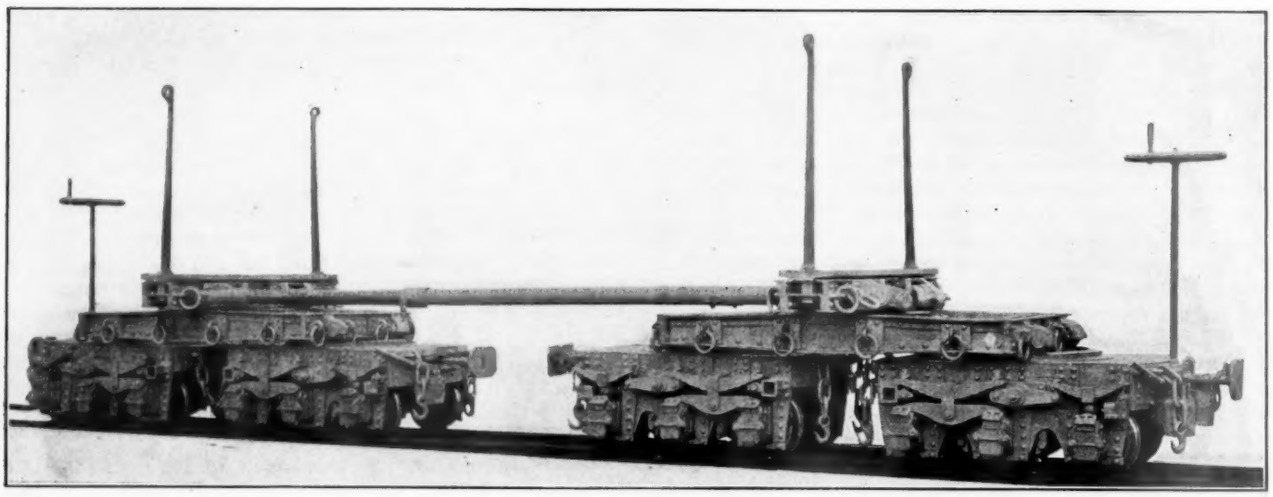
They have little or no opportunity of spending money for necessities at the front.

It is undemocratic to have men serving in the ranks alongside one another with different rates of pay for their patriotism, as must happen if enlisted men receive individual allowances from their respective employers; and such differentiation has been found to be a contributing factor towards desertions from the ranks.

It has been found that men fraternize together in the trenches under circumstances which lead to exchanges of confidence as to the result of a few days' intimate acquaintance not possible under normal conditions. They receive letters from home; knowledge of differences in the standards of family maintenance, emphasized by assistance from several sources, breeds discontent, and discontent leads to desertions.

The fundamental aim of the present readjustments of methods on the part of the foreign governments referred to, the report concludes, seems to be: (a) To establish equality in the basis of service in the ranks; (b) to equalize the burden upon industry and people; and (c) to avoid duplication of patriotic organizations and funds, and to combine all the machinery of family maintenance with an eye to the psychological effect upon the soldier at the front.

Arrangement of Six-Wheel Trucks with Platforms, Swivel Supports and Reach Bars for Heavy Artillery, Built by the National Steel Car Company



Work of the Commission on Car Service

Methods of Regulating the Freight Equipment of the Railroads as a Pool. Increasing Efficiency of Car Supply

UNDER the plan of organization of the railways of the United States as a continental system during the war, the important function of generally directing and supervising the distribution of the freight car supply of the country, in order to obtain the maximum efficiency in the use of freight car equipment during a period which began under conditions in which the demand has considerably exceeded the supply, has been delegated to the Commission on Car Service of the American Railway Association, now a sub-committee of the Railroads' War Board.

The Commission on Car Service, originally a standing committee of the American Railway Association, was reconstituted at a meeting of the executive committee on December 5 as a successor to the Committee on Car Efficiency, which had been appointed to sit at Washington in co-operation with the Interstate Commerce Commission in the endeavor to relieve the situation of car shortage and congestion. After the Interstate Commerce Commission had issued its report on its car supply investigation on January 18, 1917, the commission was again reorganized on February 2, with C. M. Sheaffer, general superintendent of transportation of the Pennsylvania, as chairman, and given plenary powers until May 1 to deal with the car situation in co-operation with the Interstate Commerce Commission by a signed agreement of the roads to obey the new code of car service rules adopted at the same time. It was also given authority to make such necessary modification in the rules as might be required.

At the meeting of railway executives held in Washington on April 11, at which the whole problem of co-operation with the government was committed to the Special Committee on National Defense, the commission on Car Service was made a sub-committee of that body and is now under the jurisdiction of the executive committee. Some additional members were appointed and the committee is now composed as follows:

C. M. Sheaffer, general superintendent of transportation, Pennsylvania Railroad, chairman; W. L. Barnes, superintendent of transportation, Chicago, Burlington & Quincy; W. C. Kendall, superintendent of transportation, Boston & Maine; Macy Nicholson, assistant to vice-president, Great Northern; G. F. Richardson, superintendent of transportation, Southern Pacific; J. A. Somerville, general superintendent of transportation, Missouri Pacific; and D. E. Spangler, superintendent of transportation, Norfolk & Western. H. W. Stanley is assistant chairman of the commission.

How the Commission on Car Service "Does Its Bit"

RULES controlling movement of cars according to ownership changed.

Shifting of box cars now in hands of Commission on Car Service.

Local committees have been organized to deal with local conditions.

Many specific orders already have been issued to railways to move cars.

How fuel is dealt with.

How shipments for the allies are being handled.

Freight Equipment Pooled

The new situation created by the declaration of war with Germany and the new organization of the railways as a national system, therefore, gave to the Commission on Car Service in addition to the work on which it had been engaged, the important function of trying to fit the available supply of freight equipment to the new and greatly enhanced demands incident to the war. Full authority was conferred on it by the Executive Committee of the Special Committee on National Defense, the "Railroads' War Board," to amend or suspend any or all rules affecting the handling of freight cars; to relocate such equipment; to issue such rules, regulations or instructions as the exigencies of the situation may, in its judgment require. On April 26 the executive committee approved a new set of rules and regulations to govern the handling of freight cars established by the commission and set forth in its General Order No. C. S. 1, which the executive committee called on all roads to make effective at once. The old rules which restricted the movement of box cars according to ownership, were so modified by the new rules as to permit a wider latitude in the handling of cars in the interest of national efficiency as distinguished from that of individual roads.

Under the new regulations the Commission on Car Service acts virtually as the manager of a car pool embracing all the railroad-owned freight equipment in the country, amounting to over 2,500,000 cars, and while rules were established governing the handling of special equipment which recognize the right of the owner to their return, the box cars are actually pooled by a rule that they "shall be used in the best interests of the requirements of traffic originating on each road," subject to the regulation of the commission "as the exigencies may require." The rules also provide that:

"A railroad may refer to the Commission on Car Service any situation where car efficiency is involved, or may appeal concerning the handling and use of its freight equipment by another railroad. The Commission on Car Service will investigate such cases and render decisions as the facts and conditions may warrant."

The new car service order suspended the principal provisions of the rules adopted on February 21, and is admittedly a war time emergency measure, a fact which has been frequently overlooked in discussions of the subject. In fact, in the circular promulgating the new rules they are referred to as "regulations" to apply until further notice. Under the Esch-Pomerene bill recently passed by Congress complete jurisdiction over car interchange and car service

rules was given to the Interstate Commerce Commission, but in such a way that the commission need only exercise a general supervision as long as it is satisfied with the work of the Commission on Car Service.

Car Service Rules

The rules which were superseded by the order of April 26 had represented efforts to deal with the knotty problem of car interchange in a more permanent way. New rules had been adopted by the American Railway Association on November 15 following an investigation which showed that on a limited number of the principal and typical railroads in all parts of the United States there were more than 40,000 violations of the rules in a single month. An effort was made in framing these rules to give them "teeth that will work automatically" by providing new penalties for diversion. The administration of these rules was placed in the hands of the emergency Committee on Car Efficiency, which was sent to Washington to co-operate with the Interstate Commerce Commission in dealing with the car congestion in the east and car shortage situation in the west and south, but the committee soon found that the situation had got beyond the reach of rigid rules and emergency orders were soon resorted to. Because of the unusual drift of traffic caused directly and indirectly by the European war, as well as the past neglect of the carriers to observe car service rules strictly, the equipment had been badly scattered, and in the effort to relocate it the effective date of the new penalties was postponed until January 1.

An attempt was made to shift box cars in large lots without regard to ownership, first getting the excess out of New England territory and requiring lines between Chicago and New York to deliver a specified excess of box cars to western and southern roads. The Commission on Car Service and the Interstate Commerce Commission through Commissioner McChord had also endeavored to bring about the return of open top and refrigerator cars to their owners.

The opinion prevailed in some quarters that if the commission had received promptly the assistance of the railroads involved, and their full co-operation in efforts to improve the general situation, this policy might have been successful, but some roads co-operated to a large extent, some did something in the desired direction and some did very little, if anything. As a result the Interstate Commerce Commission, which had undertaken a general investigation of car supply beginning November 4 and which, through Commissioner McChord and Examiner Attorney F. B. Dow, had been in constant touch with the work of the Commission on Car Service, decided by a vote of 4 to 3 to take the bit in its own teeth and issued its order of January 18 prescribing a partial code of car service rules, only a short time after it had asked Congress to give it authority to take such action. Before the effective date of the Interstate Commerce Commission rules, however, the reconstituted Commission on Car Service (endowed with plenary power) went to Washington to secure a relocation of cars, and the Interstate Commerce Commission gave the roads another chance by postponing the effective date of its order.

Mr. Sheaffer was made chairman of the new committee and the new code of rules adopted in the A. R. A. proved sufficiently satisfactory to the commission so that it postponed its own rules and allowed the A. R. A. rules to become effective on February 21. Under the new rules, with better weather conditions, with some pressure from the Interstate Commerce Commission and with a new effort on the part of many railroads, conditions were somewhat improved and the Interstate Commerce Commission on February 24 issued a statement commending the work. While the results were generally satisfactory, the shortage had reached nearly 150,000 cars by May 1 and there were many criticisms of the new rules and the practices under them, in some cases based on their observance and in others because of their non-observance. Some roads refused to observe them and shippers complained both because they did not result in giving them the cars they wanted and because under their strict observance inbound cars made empty could not be reloaded except toward home. Whether or not the rules would ultimately have proved successful and whether they were in effect long enough to provide a fair test under the difficult conditions in which they had their inception, is probably still an open question, but the fact that they were suspended and the new regulations substituted for them was the direct result of new conditions brought by the war.

The law requires the railways in time of war or threatened war to give precedence and preference to the transportation of troops and material of war. As soon as it became necessary to move freight for the government, therefore, rules which imposed a penalty for loading cars in a direction contrary to that of the home road were manifestly unworkable. After one or two instances in which roads had had to move cars in contravention of the rules in order to give prompt movement to shipments for the government it became evident that the diversion penalties would have to be suspended and at the same time the penalties that had accrued under per diem rule 3 were cancelled. This was done in General Order No. C. S. 1, which represented the first work of the Car Service Commission under its new authority.

The new rules were promulgated after conferences between the Car Service Commission and the Executive Committee in which Commissioner E. E. Clark of the Interstate Commerce Commission participated as an ex-officio member of the Executive Committee. They also contained an emergency rule framed to give preference to coal and iron ore traffic, and at the same time the Executive Committee issued a circular to the railroads requiring that special and continuous preferential service be given until further notice to the movement of those commodities. Much of the attention of the Car Service Commission has been directed to the carrying out of this order and to the handling of the multifarious details involved in securing an adequate supply of fuel.

Under the new conditions the Commission on Car Service naturally found it necessary to expand the organization which had previously been developed. It has a considerable office force and 18 inspectors who conduct investigations and keep in touch with conditions at the principal centers of interchange. Each member of the commission has assigned to him certain subjects to which he devotes special attention. Some of these assignments are: Grain and food products; lumber loading and movement; interchange between railroads and local committees; intensive car loading and relocation of equipment; coal, iron ore and materials for furnaces and steel plants; and distribution of open top cars; embargoes, accumulations and similar matters. In addition each member may handle any special problem that develops in his own territory, for the commission was organized with a view of securing representation from all sections of the country.

Local Committees

One of the first steps taken by the commission under the new regime was to organize local committees at 25 important commercial centers, to act for and in conjunction with the Commission, with representatives of all lines in the city as members and with one of the local operating officers as chairman. There had previously been a number of local committees, but steps were taken to more closely co-ordinate the local committees with the commission and to decentralize the work to a large extent in order to relieve the commission of many details and in order that

there should be some authority in a position to deal with local problems directly. The work is done by the various railroad officers as a part of their regular duty, and they do not become directly a part of the staff of the American Railway Association, although in one or two cases the work has been of sufficient magnitude at certain terminals to warrant the employment of a special man to devote his entire time to the work. In that case he is paid by the terminal lines.

The local committees were requested to meet at least twice a week. The scope of their discussion is unlimited, and their action is not restricted except by general instructions and the car service rules. They are expected to anticipate difficulties and to apply remedies to avoid complications. Weekly reports are rendered by the local committees to the commission at Washington. In addition to more general matter submitted by the local committees, weekly statements are rendered by all carriers showing the average daily car requirements, average number of cars furnished daily and percentage of average daily requirements filled. In order that it may have a check on any inequalities of distribution the commission also receives a weekly report on interchange of cars by classes.

The local committees give special attention to such matters as intensive loading of cars and the elimination of delays in loading and unloading. They keep in close touch with shippers, and at some points committees of shippers were promptly organized to deal with and co-operate with the railroad committees. On May 25 the National Industrial Traffic League organized both a central committee and local committees to co-operate with the committees representing the railroads and also the government in promoting transportation efficiency.

Sub-committees have been organized by the local committees at various points to specialize on such subjects as intensive loading. At Galveston the local committee has been making an effort to arrange for the operation of the five local switching lines as one organization in order to eliminate unnecessary handling of equipment. This committee has also considered a plan of pooling switch engines and switching crews. The committee at Memphis has subcommittees on intensive loading; prompt disposition of inbound and outbound shipments; prompt furnishing of billing; prompt switching, inspection and movement; and accumulations and embargoes. The local committees make suggestions to the commission and the commission makes suggestions to the local committees.

The instructions to the local committees regarding the objects which it was desired to accomplish included the following suggestions:

To Reduce Accumulation

This subject, of course, is the most important one, and has many difficulties perhaps, but we feel that if the local men on the ground act as a unit much good will result. Possibly the business men's association might have to be called upon to expedite disposition of accumulated loads, and their friendly co-operation should be cultivated. Consignees of large shipments might be induced to temporarily increase warehouse facilities. Possibly some lines might be helped out by borrowing switching or road

Commission on Car Service

W. L. Barnes

C. M. Sheaffer
Chairman

H. W. Stanley
Assistant Chairman

W. C. Kendall

G. F. Richardson

J. A. Somerville

D. E. Spangler

M. Nicholson

engines from lines more fortunate. A reciprocal use of yard tracks temporarily might avoid a serious congestion.

To Administer Embargoes

Careful study of this subject must be given and embargoes resorted to as last resort to compel obedience to car service rules and to regulate receipts according to ability to dispose.

The opinion of the local committee should be called for before executive action is taken on embargoes.

To Regulate Car Supply

This is an important subject for the local committee and requires daily supervision to see that an equitable distribution is accomplished. Some firms receive many more loaded cars than they should be permitted to load out and care should be taken to regulate the loading out of cars by such firms. The ability of some shippers to appropriate equipment is greater than others and in some cases undue means have been used to influence local yard employees. Many other points must be given special attention under this subject, which local co-operation only will improve.

To Promote Intensive Car Loading

The shortage of equipment has caused an increase in average tons per car, but there is still room for improvement and thereby making two cars answer where three are now used.

So many possibilities for improvement present themselves under this head that special attention will be given the subject by one of the commissioners to help out the local committees.

In addition to above suggestions it is the purpose of the commission on car service to refer many matters to the local committees for attention as thought advisable from time to time, and we will require advice of results accomplished. We want a record of the proceedings of each meeting kept and a report of such made to our committee promptly. We must also have reliable information as to local difficulties, whether overcome or not, in order to properly answer complaints coming to us and thereby properly defend or explain the railroads' actions.

We feel sure of the success to be accomplished by proper local co-operation, and hope you will expedite the organization of the local committee.

It is the intention to not have more than one committee representing this commission in any city and if an organization has already been formed, its duties must be expanded to handle all other subjects this commission may take up.

Relocation of Equipment

One of the most important tasks undertaken by the Commission on Car Service has been the relocation of equipment. It issues a bulletin semi-monthly showing the location of cars with respect to percentage of ownership, separated as to classes.

The commission announced in its car service order that roads having on their line in excess of 100 per cent of their ownership, treating each classification separately, would be expected to so regulate their car handling as not to exceed the percentage as of April 1. The condition as of April 1 was taken as a starting point to work from because the conditions as of that date represented the drift of the traffic after six months of regulation of the car supply. In carrying out this purpose the commission during the week of May 19 issued orders for the movement of several thousand cars from roads which had excess to roads which needed cars for the movement of materials required for military purposes, or for other pressing requirements. For example, the Pennsylvania was ordered to deliver 5,000 empty box cars to other lines, the Boston & Maine was ordered to forward 2,000 empty cars west at the rate of 200 a day, the Chicago & North Western was asked to forward 300 box cars to the Louisville & Nashville and 200 to the Southern, the New York, Chicago & St. Louis 500 empty box cars to the Toledo, St. Louis & Western, the Southern 1,200 box cars to the Mobile & Ohio and 500 to other roads.

These orders were followed up to see that they were complied with. The reports showing percentages of ownership are carefully watched and if a road having an excess shows an increase in the percentage over that of April 1 a letter is written to the president calling his attention to the fact, and requesting him to take steps to reduce the excess and to advise the commission as to the action taken. Occasionally a road advises the commission that it has a certain number of cars available for other roads and the commission arranges for their distribution where they will do the most good. Officers of various roads appear before the commission frequently to discuss the situation in their territory, and the commission calls on them very freely to appear and explain conditions. Usually the transportation officers confer with the commission, but occasionally the presidents or other executive officers have been called to Washington. Some roads have tried to restrict certain classes of their cars to system lines, but the Commission on Car Service has taken the position that this is wrong practice and has discouraged it.

Examiner Gutheim and Inspector Semple of the Interstate Commerce Commission attend meetings of the Car Service Commission and keep in close touch with its work.

Expediting Freight Shipments

Another task of the commission, which recently has occupied probably more of its attention than most other matters, has been to deal with the vast number of requests for priority in car supply and in movement. These questions have been brought to its attention by agencies of the government, by members of Congress and by commercial interests, and have involved not only requests for action to provide cars for and to expedite shipments of various materials of all kinds entering into the manufacture of war materials, but also of other kinds of freight for which an argument as to its special importance might be made.

Ever since its organization the Commission on Car Service has been busy receiving delegations of shippers asking that special efforts be made to furnish them cars or that their shipments be exempted from embargoes. The commission has investigated each request, and where conditions warranted it has arranged with the roads concerned to furnish the desired relief. On March 5 the commission issued a recommendation to the roads that they exempt from embargoes so far as local conditions might warrant or permit such shipments as live stock, perishable freight, shipments consigned to the United States, food-stuffs and feed for livestock, tin cans for food containers, printing paper, fuel and materials and supplies consigned to railroads. At various times circulars have been issued to the roads calling their attention to the importance of providing cars for and giving prompt movement to various shipments such as fertilizer, seeds, agricultural implements, drugs, medical and surgical supplies, and after the order had been issued to give preference to coal and iron ore it bceame necessary to request special attention also to moulding sand, fluxing stone and other basic supplies needed by steel plants.

The department of agriculture has made many requests for special consideration or relief from embargoes for articles affecting the food supply, such as tin plate for cans.

President Wilson's Request for Priority Legislation

When the order to give preference to coal and ore was issued it was stated that similar orders might be issued as to other commodities, but so many requests for priority came in that it was decided that the responsibility was too great for the railroads to assume, and President Wilson asked Congress to pass a law authorizing him to appoint a commission to decide what classes of traffic or particular shipments should be given preference. Bills introduced in Congress in accordance with this recommendation of the President provide that the machinery of the railroad committees shall be used in carrying out such orders but that the responsibility shall be placed upon the government for deciding what shall have preference This legislation is not, at this writing, assured, and the railroad committees have refrained from issuing any additional priority orders except as to government freight, which is provided for by law; but recommendations are occasionally made to the individual roads.

Shippers write letters or call at the commission's office saying they cannot get cars or want to be assured of a car supply for certain shipments, either of raw materials needed for the manufacture of war materials to fill government contracts or of some commodity which may be considered to be affected with a public importance. They are asked to

give a list of the commodities needed and of their sources and the matter is investigated and called to the attention of the originating roads. In a case of importance, if the originating road cannot provide cars for loading, connecting lines are asked to furnish them.

Unusual channels of traffic have been created by the multitude of government contracts. Manufacturers that have heretofore done business on a very small scale now have contracts for large quantities of materials and require more transportation than ever before and raw materials are moving in new directions, all of which has required special efforts to meet the demands. Soon after war was declared it was found that many people and industries were trying to stock up with more supplies than were needed at the time in order to provide for the future and some very pressing requests were made on this account. So many requests have been made for special attention by shippers claiming to have contracts for the government or for the allies that the commission has adopted the practice of checking up with the government or the representatives of the Allies before taking any action on such requests.

The Handling of Fuel

In order to prevent the uneconomical empty haul of open cars, the commission has arranged for the movement of coal for naval use from mines in West Virginia to the Pacific Coast in box cars, and efforts are being made to restrict the use of open cars so far as possible to fuel and to have them promptly returned to the owning roads, which are the roads originating the coal traffic. The Commission on Car Service has acted in close co-operation with the Committee on Coal Production, a sub-committee under the Advisory Commission of the Council of National Defense, composed chiefly of coal operators, and plans have been worked out for the more efficient handling of lake cargo and tidewater coal in co-operation with the steamship operators. At the suggestion of the coal operators' committee roads have been requested to abandon the practice of cross-shipping coal. It was found that some roads have purchased coal at points off their line in order to gain a slight advantage in price to such an extent as to compel other consumers in the vicinity to go long distances for coal that could have been used by the railroad with a considerable saving in transportation.

The preference given to coal and ore has produced a complication because open cars are also needed for shipments of sand, gravel and crushed stone, particularly for road building. Many complaints have been received from contractors who have been unable to complete contracts because of inability to obtain shipments and who would be placed in a serious financial condition if required to stop work. For this reason the commission has endeavored to give them some assistance.

Shipments for the Allies

A great deal of attention has been given to the movement of grain and other foodstuffs for the allies. The commission keeps in close touch with the representative of the British government in charge of these orders and with the progress being made in filling them, effecting arrangements where necessary to have cars furnished and to have the shipments expedited. For the purpose of equalizing the car supply the commission insists on the delivering road returning cars to the lines from which they were received loaded with grain or on their exchanging an equal number of cars. Weekly reports are received on the grain situation.

Another important work on which the commission is engaged is endeavoring to have cars repaired promptly. It has been checking up reports from the roads as to the condition of their cars. On May 1, 105 roads reporting showed an average of 5.7 per cent of cars on line in bad order, as compared with 5.4 per cent on April 1. Of these 15 roads reported less than 3 per cent of bad order cars. Where the percentage was greater than 4 the roads were asked to explain the reason and endeavor to reduce the percentage. The reports indicated a very general shortage of labor for car repair work.

Intensive Loading

The matter of securing heavier loading of cars has received a great deal of attention on the part of both the Railroads' War Board and the Commission on Car Service. In another article some of the work accomplished in this direction on individual roads is described. A general campaign of education both among railroad officers and employees and among shippers has been undertaken, and no opportunity is lost to give prominence to its importance in letters which go out from the commission's office and in conferences with the shippers. It has been taken up in conferences with individual railroads by members of the commission and by their inspectors, and also by the local committees.

The inspectors report examples of uneconomical loading and make suggestions as to commodities which present particular opportunities for improvement in this respect. Frequently when a delegation of shippers appears before the commission with statements that they have so many carloads to ship but are only receiving a smaller number of cars it has been possible to show them that by proper loading the number of cars available would suffice. Examiner Gutheim and Inspector Semple, in reply to complaints about car shortage, have also taken occasion to call attention to the need for greater economy in the use of cars, pointing out that the railroads are handling an abnormal business and that it is necessary not only to load and unload cars promptly but to load them to capacity. Conferences have been held with representatives of the department of agriculture and they have undertaken to push the campaign in their bulletins and other publications. Individual shippers and traffic associations have also been prompt to offer their co-operation, and in many large plants throughout the country orders have been issued not to let a car go out lightly loaded. The Commission on Car Service recently issued a circular to the roads urging better attention to the "trimming" of coal loads in order to secure better loading. One road proposed the issuance of a general embargo against cars loaded to less than capacity, but it was suggested that the road first try out the plan locally.

The commission recently issued a circular to all roads pointing out possibilities of conservation of box car supply at package warehouses, and reports received from individual roads indicate encouraging progress being brought about by the doubling up and consolidation of merchandise car schedules, first by discontinuing scheduled cars that customarily run lightly loaded and, second, by holding cars over for two or three days until they are properly loaded, where the freight house room will permit of this. One road reported a saving of from 50 to 100 cars a day under this practice at one of its heavy terminals and from 12 to 15 cars daily at other points.

Don't "Pass the Buck" to the Commission

The Commission on Car Service has received a gratifying co-operation from the railroads generally, although there has been an apparent tendency in some quarters to try to "pass the buck" to the commission when it has become necessary to do something that is unpopular with shippers, instead of explaining the matter from the broad standpoint of the greatest good for the greatest number. The commission is the representative of all the roads and its work in the general public interest would be promoted if all railroad officers would keep the fact prominent, with a full appreciation that it will be frequently necessary, in carrying out the orders and recommendations of the commission, to sacrifice what

may seem to be their individual interests. Some roads have made public complaints because they have had less than 100 per cent of their equipment on their lines, calling attention to records showing they were only able to fill a certain percentage of their requirements for cars, although as originating carriers they may never have had a full percentage of their cars on their own lines, except in dull seasons, and although if at once given a large number of cars they would be immediately scattered to delivering roads so that the percentage would fall. Figures showing that a given road has been able to meet only 60 per cent of its requirements are misleading unless accompanied by comparisons of the number of cars actually loaded this year and last and of the volume of business to be moved. Many roads have moved 50 per cent more coal this year than last and yet show a smaller percentage of cars on their lines.

The commission has devoted a large part of its time to reconciling differences of opinion, both between railroads and between railroads and shippers. People go to the commission with complaints regarding their local conditions, but when shown their relation to the general situation invariably leave with a broader viewpoint.

It might be expected that the movement of so many cars to fill the emergency orders would create a good deal of empty mileage, but the experience has not shown this result, because the normal empty movement is westbound and the cars to fill special orders are moved from the congested eastern lines to the west and south. There has been, however, some shifting in the location of the empty mileage.

Car Pooling Here and in England

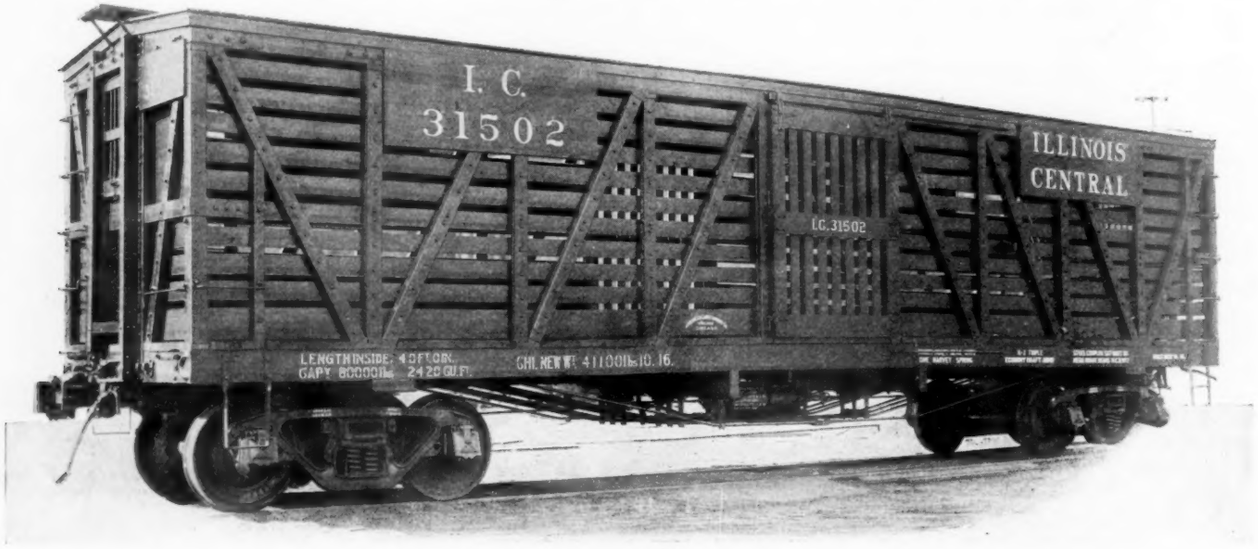
It is interesting to note that the arrangements for the practical pooling of freight cars in this country came much quicker than did a somewhat similar development in Great Britain, where the government took over the control of railway operation as soon as war was declared. Although limited arrangements were made for the common use of cars as between certain lines, it was not until January 2 of this year that a plan was adopted in Great Britain by the Railway Executive Committee by which all open "goods" and coal cars suitable for general purposes might be loaded to any station on or beyond the line of any of the controlled companies, irrespective of ownership or of the routes by which they were received. Under the plan adopted there was a primary equation of cars as between 12 principal companies, and a record is kept of the interchange from which daily balances are prepared. The balances are adjusted by the "repayment" of a corresponding number of empty cars.

Construction of Wooden Freight Equipment

Substitution of Wood for Steel Should be Made with Care—Description of Designs Used on Illinois Central

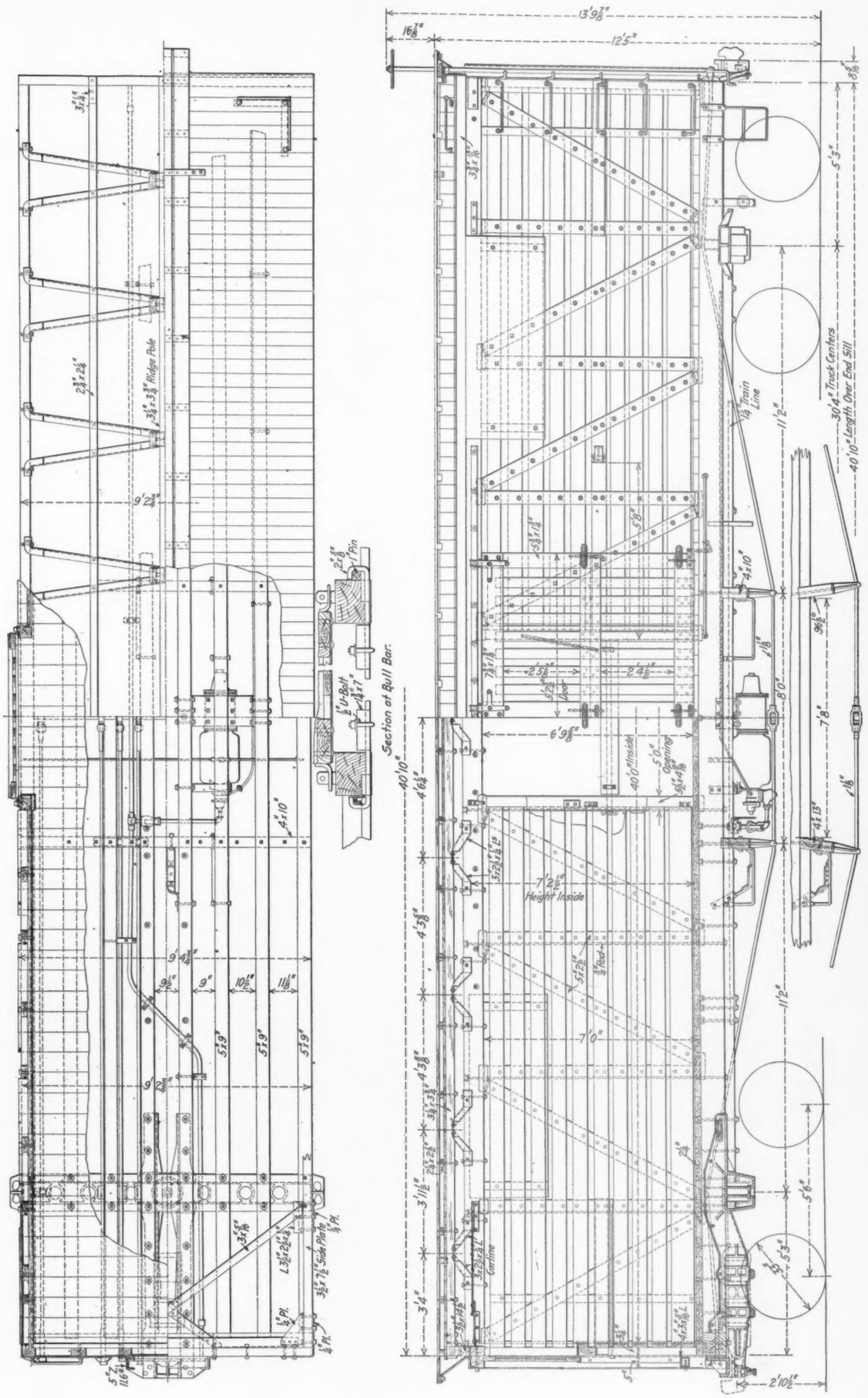
IT is apparent that if the railroads are to secure promptly the amount of rolling stock that will be required to handle business during the war it will be necessary to use considerable wood in the construction of freight cars. A supply of wood can be secured with little delay and the price has been advanced only 30 per cent at the mills during the last two years, while deliveries of steel shapes in considerable quantities can seldom be secured in less than a year and the price has risen 100 per cent.

In spite of these conditions, however, the railroads in their desire for additional equipment should not rush headlong into the construction of all-wood equipment. Careful study must be given to the design where wood is to be used in place of steel. Any attempt to provide a haphazard, makeshift construction is sure to end in disaster. The equipment must be built to last and to keep as free from the repair track as possible. Those roads that are building equipment simply to get over this year's peak, trusting that conditions will be relieved next year are liable to severe disappointment.



Wooden Stock Car; Illinois Central

Operating conditions are at their worst and freight cars of weak construction placed in tonnage trains are sure to cause delays and losses far in excess of the value of the cars. If wood is to be used it should be used judiciously. Some of the 50-ton all-wood coal cars that have found their way into



Elevation and Plan Views of the Illinois Central Stock Car

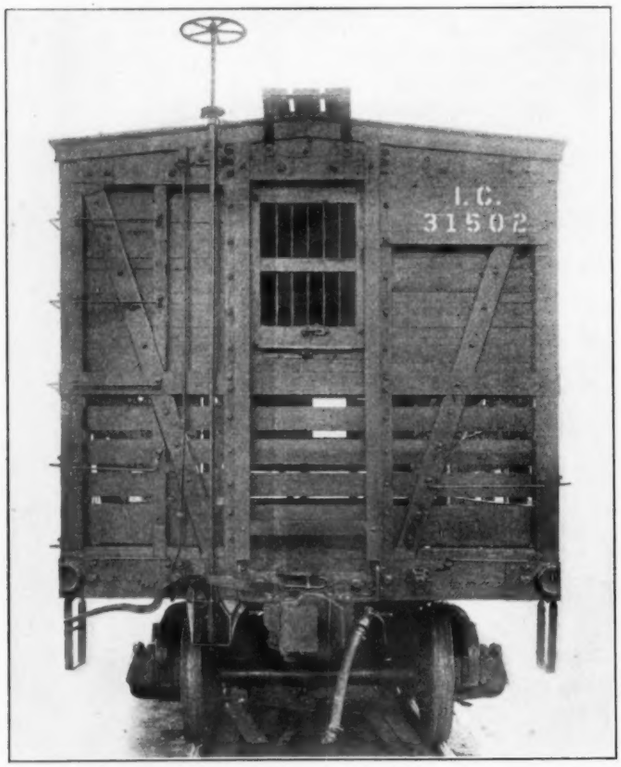
service should be eliminated from interchange traffic, as they are not able to stand the punishment of heavy service. Some such cars weighing 40,000 lb. and built less than two years ago are now ready for reconstruction. The steel underframe should be demanded on cars of the drop door type.

The house car presents an opportunity for the more extensive use of wood. Here, too, the underframe should preferably be of steel, although well designed composite construction may be used to advantage. In all cases the M. C. B. standards for such construction should be carefully followed. Special care must be taken to have the superstructure properly braced.

A successful design of wooden car which was built to meet the present conditions is illustrated by the 300 stock cars which were delivered to the Illinois Central several months ago by the American Car & Foundry Company. These cars, which were designed by the railroad company, are constructed largely of wood, but have cast steel bolsters, draft arms and striking plates, steel reinforced ends and steel carlines. They have been so satisfactory that it is planned to build another lot of similar design.

The cars are of 80,000 lb. capacity and have an average light weight of 41,000 lb. They are 40 ft. long inside and 40 ft. 10 in. over the end sills. The width between the belt rails is 8 ft. 6¼ in. and over the eaves 9 ft. 7¼ in.

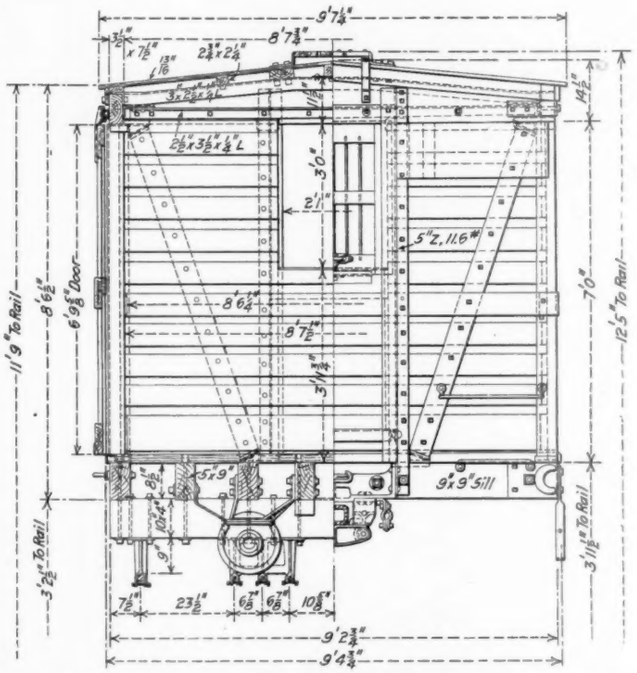
The main draft members are made up of two 5-in. by 9-in. sills, to which are attached cast steel draft arms, designed to



End View of Illinois Central Wooden Stock Car

meet M. C. B. requirements. Above the draft arms and riveted to them is a cast steel striking casting. Two of the truss rods pass through the casting and the Z-bar end posts are riveted to it on either side. The double pocket coupler is fitted with one M. C. B. Class G draft spring and one 8-in. by 8-in. friction spring. The end framing is a combination of steel and wood types. On each side of the door openings at the end is placed a 5-in., 11.6-lb. Z-bar which is riveted to the striking casting and bolted to the end plate. Inside the Z-bars and bolted to them are two 5-in. by 3¼-in. wood posts. The diagonal end braces are 5 in. by 3¼ in. and the ladder cripples are 3 in. by 3 in. The end belt rail is reinforced by a steel tie 5 in. wide and ⅜ in. thick fastened to the Z-bar end posts and to the side belt rail. Steel corner plates are fitted at the intersections of the side plates and end plates and side sills and end sills. The end slats and belt rail are 1¾ in. thick.

The underframe is made up of eight 5-in. by 9-in. sills, with cast steel bolsters and 4-in. by 5-in. sub-sills under the draft sills. The end sills are 9 in. by 9 in. and the needle beams 4 in. by 10 in. Waterproofing is applied over the sills



Half End View and Section of Illinois Central Box Car

under the floor. There are eight 1⅛-in. truss rods with 1⅜-in. upset ends arranged in two groups of three near the center line and two single rods close to the side sills.

The upper framing, except the ends, has wooden posts. The corner posts are 5 in. by 5 in., the door posts 5½ in. by 4 9-16 in. and the intermediate posts and king posts are 5 in. by 2½ in. The posts fit into malleable iron pockets at both top and bottom and are rabbeted to receive the ¾-in. vertical tie rods. The side plates are 7½ in. by 3½ in. mortised for the tenons of the end plates and tapered on the upper edge to conform with the roof purlines. The center belt rail is 1¾ in. by 5½ in. and is located 2 ft. 10¼ in. from the floor. The bottom belt rail, or base board, is 1¾ in. by 9 in. set to give ¾ in. clear opening above the top of the floor. The side slats are 1⅛ in. by 5½ in. spaced with 2 in. openings between the slats. The belt rails and slats are bolted to the side posts and all inside edges are rounded. The flooring is 2¼ in. thick, butt edged. At the side door threshold a 2½-in. by 2½-in. by ¼-in. steel angle is applied.

The roof is of the single board type 13/16 in. thick. The ridge pole and the four purlines are of wood supported on carlines of 3-in. by 2½-in. by ¼-in. angles which are bolted to the side plates. Cast steel side frame trucks are used under these cars. The air brake is the New York Air Brake Company's schedule C F-C-10.

The Illinois Central is now planning to build several hundred stock cars in the company's shops which will be duplicates of the former order. There will also be built box cars which will be of similar construction but equipped with all-steel ends, steel roofs and metal-bound doors.

A Review of the Material Situation

The Railroads of the Country Are Badly in Need of Supplies for the Maintenance of Way and Structures

ON June 5 several of the large steel companies withdrew from the market, because the production capacities of their plants were contracted for so far in advance that they were unable to consider additional business. While this condition has existed in a more or less indirect way for some time with regard to a few products, these formal announcements constitute a definite culmination of conditions in the steel market which it has been approaching since the beginning of the European war. The requirements of the warring nations for steel in all forms, but particularly for munitions have made large demands upon the iron and steel furnaces and have taken up a material proportion of the rolling mill capacities. Enormous demands, both foreign and domestic, have also been made for structural steel to supply the shipyards and these have been later increased by the demand for structural steel for cars and for the building of the industrial plants that have sprung up to supply the war trade.

War business is emergent, and price is a secondary object. Consequently prices were rapidly adjusted to the requirement of quick delivery, and the relation between supply and demand was expressed by a filling of order books further and further in advance. Quotations continued to rise, and since the early part of 1915 there has been practically no let up in the upward march of prices. Production also has been increased materially by enlarging plants, but not in proportion to the demands. The table shows this increase in material costs for a number of commodities used extensively in railway maintenance of way work.

In the latter part of 1915, when the railroads found their earnings increasing to an extent that enabled them to go into the market for their normal requirements of materials, equipment and supplies, prices had already advanced to figures that were so unusual that many were reluctant to buy, hoping that a few months would bring a turn of affairs that would effect a reduction. Few believed that the war would continue so long or that prices could be maintained on a steady upgrade for such an extended period. Because of this tendency to delay purchase in the face of a rising market, buyers have been paying more for their necessities than immediate purchases would have required, and this general hesitancy to purchase has decreased the railroad stores in a considerable measure.

INCREASE IN COST OF TYPICAL IRON AND STEEL COMMODITIES

	Per 100 lb.					Per Net Ton.	
	Angle	Track		Structural Steel		Tie	Cast Iron
Date.	Bars.	Bolts.	Spikes.	Plates.	Shapes.	Plates.	Pipe.
Mar. 1, 1915.....	$1.50	$1.85	$1.35	$1.15	$1.15	$36.	$20.
Jan. 1, 1916.....	....	2.50	....	1.80	....	....	29.
Mar. 1, 1916.....	1.50	3.25	2.50	2.35	2.25	45	29.50
Nov. 1, 1916.....	2.50	3.50	2.70	3.19—4.16	2.75	50—55	31.50
Jan. 1, 1917.	2.50	4.50	3.45	3.50—5.00	3.25	55—60	41.
Feb. 15, 1917.....	2.50	4.75	3.45	3.75—4.90	3.50	60—65	42.50
Jun. 7, 1917.....	3.25	5.50	4.00	4.50—8.50*	4.50	60—65	58.50

* Quotations on plates at the present time cannot be relied upon.

Material Situation and Maintenance

PRICES of materials for maintenance of way have steadily and rapidly increased.

Government requirements may interfere seriously with railway buying.

Demand for scrap is great, and its proper use has become very important.

Rail problem has become especially serious.

Structural steel very high and hard to get.

Shortage of wood preservation presents serious problem.

The entrance of this country into the war has introduced an important disturbing factor caused largely by uncertainty as to the Government's actual requirements for various commodities and the position that it would take as to deliveries and prices. The country's needs for the conduct of its part in the war are necessarily of first consideration and manufacturers have generally placed their plants at the disposal of the Government. The latter has also made it clear in recent weeks that it will place its needs before those of private individuals or corporations, and owing to the fact that the railroads' requirements for all manner of supplies have not been fulfilled for some time, there is a possibility that the Government needs may interfere seriously with those of the railroads and produce a positive crippling of the effectiveness of railway transportation.

This danger has been recognized and the Railroads' War Board has appointed a committee on materials and supplies, the duty of which is to work for the correlation of the requirements of the railroads with those of the Government. Through this committee an inventory is being taken of all materials and supplies which the railroads have in stock that can be of use in the conduct of transportation or war. At the same time the railroads have been instructed not to dispose of any equipment, devices or materials of a usable character. From the standpoint of the railways, the important function of this committee is to bring to the attention of the Government just what the specific needs of the railways are, so that the manufacture of war or other Government supplies will not shut off the production of the necessities.

The roads themselves are generally attempting to be as forehanded in regard to this situation as possible, and are holding old materials that offer any opportunity for restoration. The Atchison, Topeka & Santa Fe, which has long followed a policy of reclamation of old materials, has recently arranged for electric welding outfits for each division, so that broken parts may be repaired. This is one of a number of measures that can be taken up profitably to save material.

The demand for scrap is great and the prices are very high, in many cases way above the prices of new materials three years ago. In consequence there is a great incentive to sell the stocks on hand. At the same time the amount of

money that can be expended with economy for reclamation operations is much higher under the prevailing high prices than during periods of normal cost, but with the imminent danger of an actual shortage of materials, even economy ceases to be a primary object and the conduct of reclamation to a maximum becomes an absolute necessity.

The Rail Situation

A most illuminating view of the railway material situation is afforded by a study of current rail statistics. Incidentally it gives a convincing demonstration of the extent to which maintenance has been deferred. The table following shows the consumption of rails in the United States since 1902, and the most noteworthy fact to be gathered from this is the relation between rail consumption for the years 1914, 1915 and 1916, and that for the years 1902 to 1913, inclusive. During the 12 years beginning with 1902, the average yearly consumption of rails was 2,837,000 tons, while the lowest figure was that for 1908 with 1,726,224 tons. However, this year was preceded by one with a consumption of 3,298,500 tons, and followed by 1909, with a total of 2,725,847 tons, so that the yearly average for the two poorest years was 2,226,035 tons. In contrast with these figures we find that the consumption in 1914 was 1,792,986 tons, and in 1915 1,891,237 tons, or an average for the two years of 1,842,111 tons.

Rail Production and Consumption in the United States

	Gross tons.	
Year.	Production.	Consumption.
1902	2,947,933	2,943,789
1903	2,992,477	3,057,195
1904	2,284,711	1,906,237
1905	3,375,929	3,098,184
1906	3,977,887	3,654,794
1907	3,633,654	3,298,500
1908	1,921,015	1,726,224
1909	3,023,845	2,725,847
1910	3,636,031	3,290,712
1911	2,822,790	2,405,330
1912	3,327,915	2,885,222
1913	3,502,780	3,052,635
1914	1,945,095	1,792,986
1915	2,204,203	1,891,237

This comparison indicates that rail renewals in 1914 and 1915 were 16 per cent less than in any two preceding consecutive years, and fully 35 per cent less than the average for the previous 12 years. Following these two years of obviously inadequate rail purchases 1916 shows a production by American rail mills of 2,854,518 tons. This is less by 300,000 tons than the average production for 1902 to 1913, inclusive, and account must also be taken of the fact that rail exports during that year were higher than normal, 421,864 tons leaving the country during the eight months ending February, 1917. Thus it is clear that rail renewals for 1916 were hardly sufficient to take care of the normal requirements for that year alone, and did nothing to replace the great deficiencies of the two previous years or—expressing it in another way—there was an accumulated deficiency in rail renewals of over 2,000,000 tons at the beginning of 1917.

The marked reduction in rail purchases in 1914 and 1915 was brought about by the extreme low level of railway earnings during those two years which compelled the railways to reduce expenses to the absolute minimum. Late in 1915 earnings began to pick up, but by the time the managements felt sufficiently assured of continued prosperity to increase purchases they were confronted with a congested market in which they had to compete with buyers to whom price was subordinate to other considerations. In consequence they succeeded in making but limited additions to the rail orders for 1916 delivery.

In April, 1916, after almost 15 years of fixed prices for steel rails, the prices were advanced from $28 and $30 per gross ton for Bessemer and open hearth rails respectively, to $33 and $35 per ton. This advance was followed in November by a second raise of equal amount, so that the present fixed prices are $38 and $40, respectively. In the meantime the railways have been compelled to advance their inquiries for future rail requirements, so that at present the market for 1918 rails is virtually closed and some large orders have been placed for 1919 delivery. Of late the mills have indicated a reluctance to accept further 1919 orders.

This condition of the rail market is reflected in the prices of old rails suitable for relaying and rerolling, which in several instances are actually higher than the established prices for new rails. Relaying rails are bringing from $39 to $46 per gross ton, while the current price for rerolling rails is $34 to $39. Frogs, switch and guard rail scrap was quoted recently at $31.50 to $33 per gross ton. Light rails weighing 45 lb. per yd. or less are selling at from $61 to $63 per ton. Further demands on the rail market were made recently in the form of inquiries from Russia, England and Sweden aggregating 265,000 tons.

Thus the railroads are in a most unenviable predicament. After three years of inadequate rail renewals they find rails 33 per cent more expensive and exceedingly difficult to get. Yet they are compelled to maintain their tracks to carry the heaviest traffic on record, with prospects of more exacting requirements with the progress of the war.

Canada's Experience

The experience of Canada may serve as an indication of the exigencies of war and of what may be done to overcome them. Rail production in that country reached a maximum of 506,709 tons in 1913. The production in 1914 was 382,344 tons, but decreased in 1915 to 209,752 tons, and in 1916 to the low figure of 81,497 tons. The manufacture of tie plates, angle bars and other joints, track spikes, nuts, etc., which aggregated 54,839 tons in 1913 and 34,165 tons in 1914, was reduced to 9,406 tons in 1915, and to 6,479 tons in 1916. In spite of this great reduction in the manufacture of these necessities, the Canadian roads have been called upon to furnish large quantities of material from their stocks of railway supplies for use on the war front in France. Last year 300 miles of rail with the necessary fastenings was taken up from track and sent overseas. A total of 225 miles of this was taken from the Grand Trunk Pacific line through Yellow Head pass, where the Canadian Northern line occupies a parallel location, and is now used by the trains of both roads. The other 75 miles was supplied by the National Transcontinental. Other calls for rails, received or anticipated, will entail the abandoning of a considerable mileage of additional lines.

The small production of track materials in Canada and the war requirements have worked a serious hardship on the railways, which, like those in the United States, are now handling a heavy business. Rail renewals out-of-face have been discontinued and such new rails as can be obtained are being used for individual replacements. This situation does not affect the recently completed lines with their new rail so much as the older roads. Conditions on some of the latter became so serious during the past year that the railways succeeded in securing an order from the Canadian Munition Board for the rolling of a limited quantity of rails in a mill otherwise engaged solely on munition work. One deficiency that is causing considerable trouble in Canada is the scarcity of spikes, bolts and other common fastenings, and special pressure has been brought on the maintenance of way department to conserve all old materials that are in at all usable shape.

The Rail Problem

The urgent need for the adequate maintenance of the American railways clearly calls for an arrangement with the mills and the Government that will provide for the rolling of the maximum possible tonnage of rails consistent with the relative importance of the various demands being made on the steel manufacturers. Entirely aside from this the rail-

roads will be compelled to exercise the most careful conservation of the rails now in track. This implies intelligent and adequate track surfacing, discrimination in the removal of rails from track and the reclamation for reuse of as much of the released rail as possible.

On tangent track, rail deterioration consists largely in the battering of joints and in surface bending. These defects can be kept at a minimum by maintaining the tracks in good surface and giving particular attention to the joint ties. Rail anchors assist materially in holding the ties on their natural beds, and in preventing the bunching of the expansion which is prejudicial to a good condition of the joints. The frequent tightening of joint bolts is another requisite if the joints are to perform their full service.

On curves the wear is distributed much more nearly uniformly throughout the length of the rail and is, of course, much more rapid. The wear on the inside and the outside rails differs materially as to character and its intensity varies with varying conditions of service and track. Several practices are in vogue for the replacement of curve-worn rails. Among these may be mentioned reversing the outside rails, interchanging the inside and outside rails and putting in new rails on the outside and replacing the inside rails with the old outside rails. The following illustrates a practice that has met with material success on the branch lines of an Eastern road.

The only rail laid on the branch for a number of years was rail removed from the main line, principally of 100-lb. section. The rail, when so relaid, had ¼-in. wear and was reversed in relaying. After the low rail had become unfit for main track use, the high side was generally worn between ½ in. and ¾ in. further. When the high rail was moved over to replace the low rail it supplied a natural "frictionless" rail. This resulted in greatly increasing the life of the renewed high rail which was of fit material released from main line, while the battered low rail was still fit for use in storage tracks operated at slow speed.

The crushing down of the rail on the low side is largely influenced by the operation of trains at a lower speed than that assumed in establishing the superelevation of the outer rail. If the superelevation can be adjusted to fit the average speed more nearly or if the schedules of trains can be readjusted to give more nearly equal velocities, this trouble can be reduced appreciably. The proposed reduction in the speed of passenger trains for fuel economy would be beneficial here also.

After the proper care of the rail in track, the next consideration is the reuse of the released rail in a manner that will insure the best results. A number of special measures have been adopted by various railroads tending to increase the life of old rail and the riding qualities of the track in which it is relayed. Among these may be mentioned the sorting of rails to insure uniform end heights, straightening, resawing and rerolling. Rails relaid without regard to variations in height give poor riding track and many roads take steps to overcome this. Some sort them into grades by variations of 1-16 in. in height. Others match-mark the rails so that they can be relaid in the same order in which

Sub-Committee on Materials and Supplies

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they were released. While these efforts are justified by the results secured they do not permit the maximum benefit of the value of the old rail, particularly if it was taken out of track because of battered ends. This has led to the establishing of reclamation plants where the damaged ends are sawed off and new joint holes are drilled. Provision is also made for the straightening of the rails and their sorting according to wear, height, etc.

As analyzed in connection with the rail reclamation plant of the Chicago, Milwaukee & St. Paul at Savanna, Ill., the gain in the salvage consists in: (1) rails recovered from scrap (the difference between their scrap and service values); (2) serviceable rails with worn ends cropped, thereby reducing the cost of maintenance; (3) increasing the life of joint ties and ballast; (4) reducing wear on motive power and rolling stock; (5) making smooth, comfortable riding tracks. The actual savings to be accomplished for 100 miles of 75-lb. rail released from track is expressed in the following statement in which the figures are based on normal prices for new rail and scrap, rather than the present high prices:

Total rails recovered	11,800	tons
Rails fit for relaying	10,620	tons
Rails fit only for scrap without sawing	1,180	tons
Cost of sawing 1,180 tons at $0.70	$ 826	
Rails recovered from 1,180 tons sawed:		
Scrap (7 per cent), 83 tons at $12	996	
Serviceable (93 per cent), 1,097 tons at $21	23,037	
Total value recovered	$24,033	
Value of 1,180 tons of scrap at $12	$13,160	
Gross gain	$10,873	
Less the cost of straightening, sawing, drilling and reloading the entire 11,800 tons at $0.70 per ton	8,260	
Net demonstrable profit from the whole operation	$ 2,613	

The rerolling of used rails into new sections of slightly less weight has been practiced in this country for a number of years. In 1916 a total of 144,826 tons was rerolled in this manner and the high price placed on all rails suitable for rerolling combined with the scarcity of new rails points to the need of a thorough consideration of the rerolling process. Under present prices the relation of the transportation cost is materially different than during normal times. Recently a modification of this process was introduced, as described in the *Railway Age Gazette* of June 1, whereby a rerolled rail having a cross section closely approximating the shape of the rail as worn in track is being produced. The Michigan Central, the New York Central, Chicago & North Western and the Chicago, Milwaukee & St. Paul are arranging for the rerollings according to this plan.

The resawing and rerolling of rails if done intelligently will serve to effect material reductions in the tonnages of new material required, since the rails reclaimed by these processes can be used with excellent results in all main tracks except those carrying very heavy traffic or high speed trains. Another aid in the solution of the rail problem suggested by the experience in Canada, and which may eventually be put into effect in this country, would be the abandoning of some of the main tracks now in use. There are many places where competing roads operate parallel tracks for considerable distances, either one of which is ample for the combined traffic. By making one track serve for both roads, the rails and fastenings of the other one can be taken up and used elsewhere. The present shortage of materials also makes advisable the taking up of those tracks which have been abandoned or for which the demand has ceased.

Structural Steel

No branch of the steel industry has been subject to such marked increases in price as that of structural steel. In March, 1915, steel plates and shapes were selling for 1.15 cents per lb. A year later they were bringing 2.35 and 2.25 cents, respectively, more than at any time since 1900. Compared with present figures, however, these prices were low, for shapes are now selling around 4½ cents and plates bring almost any price from 5½ cents up.

The extreme strain of the market conditions in the case of this material is explained by the fact that many of the mills used for rolling I-beams and other shapes have been diverted to the rolling of large rounds for the manufacture of shells. In consequence the production of shapes in 1916 was only one per cent more than in 1913, while all rolled steel combined showed an increase over 1913 of 30 per cent. Plates have had an unparalleled demand because of the expansion of the steel ship building industry and to some extent on account of the increase in steel car construction. As a large part of the increased consumption of structural steel originated in other sources that the steel fabricating shops, which ordinarily consume the bulk of this product, these shops have not participated generally in the increased business. Their plants have been operated for the most part at less than capacity and as competition in this field has been active, the margin between the price of plain material and the fabricated structures has been relatively small. The enormous advances in the cost of rolled plates and shapes has nevertheless produced a marked increase in the cost of steel bridges.

In July, 1914, railroads were paying from 1.96 to 2.15 cents per lb. for plate girder bridges ready to erect, on cars at the bridge shop. A year later the prices were practically the same, but in July, 1916, two years later, railroads reported prices ranging from 3.7 cents to 4.8 cents. A large contract awarded January 1, 1917, contained the following pound prices: I-beams 4 cents, deck girders, 4.5 cents, through girders 4.48 to 4.55 cents and riveted truss spans, 4.9 cents. About the same time a riveted Pratt truss span was let for 5.1 cents and near the first of February a number of deck girder spans were awarded for 4.8 cents. As time passes prices become increasingly variable, depending upon the delivery arrangements required or agreed upon. At present the bridge shops are waiting for definite instructions in regard to the part that they are to play in the government ship building program, as it has been proposed to distribute the steel fabricating work to shops throughout the country.

Influence of the Car Shortage

Except in the case of coal and products of iron and steel the shortage and high prices of material must be assigned to other causes than excessive demands. The producers are generally blaming the car shortage and to a lesser extent the scarcity of labor. Lumber men claim that they are compelled to curtail production because of inability to deliver. Cement producers have occasionally been compelled to use open top cars and cattle cars at the risk of losses from wet weather.

The production of cement in 1916 was 91,194,000 bbl., as compared with 85,914,000 bbl. for 1915, 88,230,000 for 1914, and the maximum of 92,097,000 for 1913. The increase last year is in line with the increased building operations of the year as compared with the two years previous. Simultaneously with this increase in consumption there has been a slow but steady advance in the price of cement so that it now costs nearly double what it did two years ago. Quotations for cement about the first of June were $1.91 per bbl. for Chicago and Pittsburgh, $2.04 for Cleveland, Indianapolis and Toledo, and $2.18 for Minneapolis and St. Paul. These are car load prices, not including package.

The agitation for a reduction in building and road construction as a measure of war economy recently threatened to cause serious inroads in the business of the cement and other building material lines, but a damper put on this movement has restored stability to the market. Nevertheless, there has been some falling off of construction operations and cement will unquestionably be available in adequate quantities at reasonable prices.

Sand, gravel and stone for use in ballast and in concrete would be available without any limitations except for the matter of delivery. The car shortage, which has been

severely felt in this field for some time, reached a crisis about two months ago when the Railroads' War Board issued an order requiring the railroads to give special preference to coal and ore traffic in the distribution of all open top cars. Some of the railroads interpreted this order as a positive prohibition of the use of these cars for any other purpose and in consequence the gravel and stone producers suffered severely. In Indiana, for instance, quarries in the vicinity of coal mines received practically no cars for a time, but upon the presentation of their case at Washington a modification of the ruling was secured which permits the quarries and pits to receive cars up to 40 per cent of the capacity output of their plants.

The purchase of ballast by the railroads was curtailed materially during 1916 because of the shortage of men to put it under the tracks. On the other hand, the production of stone and gravel has not been seriously hampered by the scarcity of labor, and with some falling off of building operations the supply of these materials will be plentiful, providing the railroads can arrange for transportation.

The prices of these commodities have advanced appreciably with the increased cost of production. However, the increases in cost are modest compared with those of the steel trade, and concrete materials, taking account of the cost of cement, will aggregate less than twice the cost before the war. This points to the more extended use of concrete, particularly by those roads that have been extremely conservative in its application.

Cost of Lumber Lately Increased

Until recent months the lumber industry has not participated in the riot of price advancement. All through 1915 and a large part of 1916, the prices of lumber were below normal, and in some cases were depressed to the level of prices in 1902. Lumber is produced in parts of the country generally remote from the localities of the recent heavy congestion of traffic and the car shortage has been most pronounced. This has complicated matters and the prices of lumber have indicated decidedly erratic tendencies in consequence of the varying relations between the demand, the production and the shipments.

Since the beginning of the war the prospect of government purchases for shipbuilding and military camps has led to sharp rises in prices ranging approximately from $5 to $8 per 1,000 ft. b.m. Much uncertainty surrounds the actual volume of the government requirements, but it can be concluded with safety that they will not make serious inroads on the total capacities of the lumber mills. Railroads tributary to the lumber regions have no trouble in securing their full requirements, but roads not so situated have suffered like other purchasers from more or less serious delays in delivery. Even at present prices of lumber, the advances are insignificant compared with those on steel. This condition has been taken into account by many of the railroads in making substitutions in their structures, particularly in the case of bridge renewals. The difference in the cost of steel and wooden water tanks has also led in some cases to a departure from the steel standard in favor of creosoted wooden tanks.

Tie Renewals

No statistics are available upon which to base any conclusion as to the adequacy of tie renewals during the past three years. An investigation by the United States Department of Agriculture indicates that the purchase of ties by steam railroads during 1915 was about 112,000,000. However, there are no figures available showing the purchases of ties in the three years preceding this so that the latest year preceding 1915 for which statistics are available is 1911, when the railroads bought 135,000,000 ties. In the absence of further information it is impossible to determine to what extent the reduction in tie purchases in 1915 as compared to 1911 results from deferred tie renewals during 1915 and what part is the natural result of the increased life obtained by the more extended use of timber treatment. The situation among the tie producers is entirely different than among the lumber mills supplying a general trade, since the former are dependent entirely upon the purchases of the railways and have no opportunity to secure a balance of the varying demands of several classes of consumers. The situation in tie production as it now stands is pictured in the following statement by a representative of this industry:

"During 1913 and 1914 the railroads retrenched all along the line, and ties were one material to suffer. During that period and for part of 1915, many of the largest tie-producing companies stopped making, and for two years not an axe was put into their timber. The usual stock of ties was allowed to decrease to a minimum and current wants were secured from the small producer, who was forced to cut his timber to supply his family with flour, meat and other necessities.

"Twenty-one months ago the railroads not only resumed their normal buying, but greatly augmented their demands for ties to rehabilitate the tracks that had been allowed to deteriorate during the period of depression. As a result, they rapidly absorbed the small stocks that remained. The two years lost in production owing to the lack of demand for ties were gone without hope of recovery, and today sees the country with an abnormal demand and no surplus ties in stock, while a depleted organization to cope with the pressing need does not give promise for immediate improvement. The offer of an advance in price will do little or nothing to bring out more ties, and, as is usual in a time like this, has but the effect of raising the price and lowering the grade."

Shortage of Wood Preservatives

One of the most serious problems of the moment is that arising from the shortage of wood preservatives which threatens to interfere materially with the progress in timber treatment by railroads. During 1912 and 1913 an average of about 100,000,000 gal. of creosote was consumed in this country, of which 62 per cent was imported from England and Germany. In 1914 the financial depression caused a decrease in the use of this material to 79,000,000 gal., of which 65 per cent came from abroad. With the opening of the European war the German supply was cut off and the English imports were curtailed temporarily by an embargo and later by certain restrictions so that the imports for 1915 were only 37,500,000 gal. By an increase in domestic production from 28,000,000 gal. in 1914 to 43,000,000 gal. in 1915, the deficiency in imports was compensated for to a sufficient extent to make the total supply in this country practically equal to that for the previous year.

During 1916 the demand for creosote oil far exceeded the supply. Statistics compiled jointly by the United States Forest Service and the American Wood Preservers' Association give a consumption of coal tar creosote for 1916 of 88,968,666 gal., valued at 7.5 to 13.5 cents per gal. The consumption of refined water gas tar is given at 1,436,083 gal., as compared with 2,024,545 for 1915, that of zinc chloride is placed at 26,746,577 lb. and valued at 3.25 to 9.5 cent per lb. as compared with 33,269,609 lb. in 1915. Information gathered by the same orginizations indicate that cross ties treated in 1916 aggregated 37,469,000 as compared with 37,035,000 in 1915.

The crisis in this industry was reached in February, 1917, when the increased activities of the German submarines caused the British government to commandeer all tank steamers for other service, thus practically shutting off the English oil. The American production of creosote for 1917 is estimated at about 60,000,000 gal., and as the demand will be fully double that figure, the shortage will be acute.

The decrease in the supply of creosote has led to increased

demands for zinc chloride and other preservatives, and in the case of zinc chloride, owing to the increased cost of production, there has ben a marked rise in price. Of the materials used in the manufacture of this preservative, hydrochloric acid is now in great demand in the manufacture of explosives and all forms of zinc have increased greatly in price.

In view of the obvious deficiency in the two most common preservatives the railways which have been leaders in tie and timber preservation are making great efforts to conserve their supplies and to investigate substitute materials. For the benefit of the growing practice of timber treatment on railroads it is to be hoped that as the largest users of treating materials they will be enabled to secure the bulk of the available supplies.

Conclusion

Today railroad supplies come from just two kinds of markets, and deliveries are slow and prices are high in both. In one the consumption far exceeds the production and the buyers are bidding against each other for the limited supply. In the other the manufacturer cannot deliver as much as he produces because the railroads have been unable to finance the necessary extensions of facilities to handle the enormous business now imposed upon them. In the case of steel products or other materials subject to war requisition there is serious danger that the railroads will not secure the supplies absolutely necessary for the conduct of adequate, safe and efficient traffic movement. The situation clearly calls for government intervention whereby the railroads will receive a proportion of the available supply commensurate with their needs.

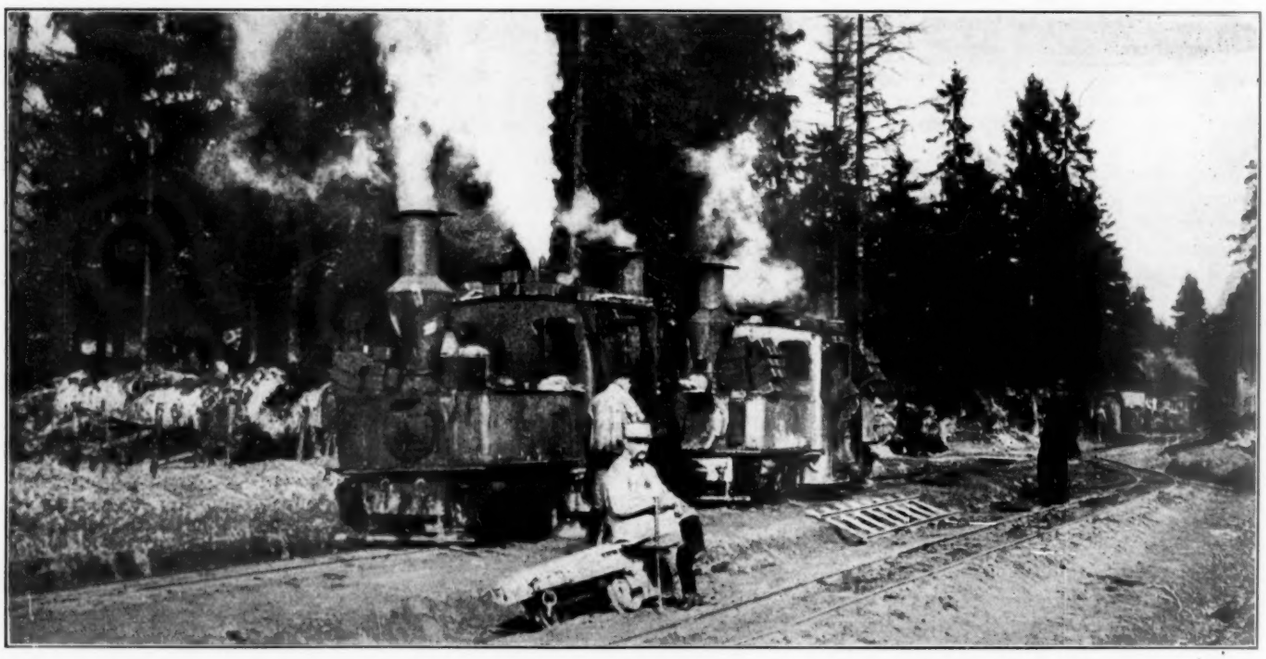
In cases where the scarcity of material has resulted from delays in deliveries through railway congestion, the problem must be solved by the railways themselves and will be, provided they can secure the co-operation of the various regulatory bodies in whose hands their fortunes now lie, to such an unfortunate degree.

For the railway men the situation calls for the conservation of all materials and equipment on hand and in use. It also calls for the exercise of ingenuity in the substitution of materials less expensive or more readily secured in all cases where this can be done with efficiency and permanency.

The Use of Light Railways in the War

Five Thousand Miles of 2 ft. and 3 ft. Gage Lines Have Been Laid Behind the Fronts to Carry Supplies

THERE are few things in transportation that the American Civil War did not introduce to military science. Americans did not, however, introduce the light railway or the motor truck, the two modern competitors for the job once held by the faithful but much maligned army mule of bygone days.



Photograph from Underwood & Underwood, N. Y.

Pechot Engines "On the Job"

It has been estimated that there are no less than 5,000 miles of 2 ft. or 3 ft. light narrow gage railway lines on the various European fronts. These railways are auxiliary to the multitudinous lines of standard gage railway that bring troops, munitions and supplies from the regions outside the war zone. Extending out like antennae from the standard gage terminals, they feed the cannon as the latter bark at the enemy across "no man's land." The light railways also bring forward other supplies for men and cannon and move the lighter and medium weight guns. Backward, they assist in a different kind of work, that of carrying the wounded to the hospitals.

Without the light railway it would be extremely difficult, if not impossible, to use artillery on the stupendous scale

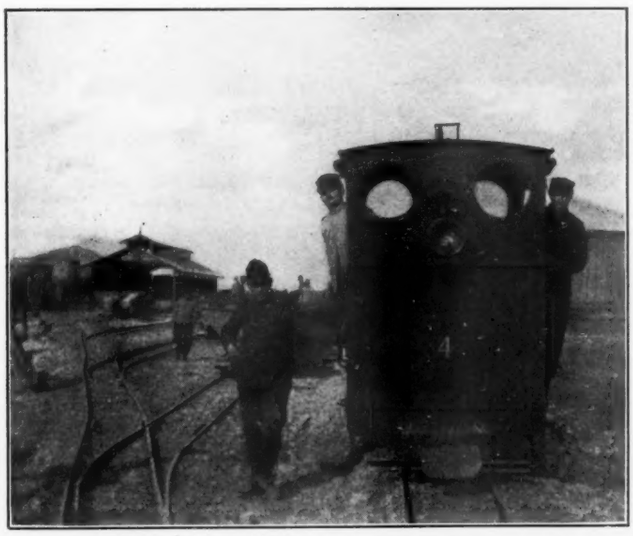
that it is being used on the western front to-day. The consumption of shells has been almost beyond comprehension. It has been estimated, for example, that the total consumption of shells in the attack and defence of Verdun was 60,000,000, representing 3,000,000 tons of steel, expended in 30 weeks. That explains, perhaps, why America did not use the light railway in the Civil War.

American railway ingenuity was not called upon to move in 30 weeks a weight of shells equivalent to three times

Shells for Some of the Big Fellows

the total pig iron production of the country in 1864. Indeed, artillery is not the same now that it once was. When Sherman spent a brief October to January on his march through Georgia he carried with him 60 guns and 200 rounds of ammunition per gun, for his entire campaign. A French 75 m.m., or an American 3-in. gun, could today fire the 200 rounds in 10 minutes. The total expenditure of shells by the 310 Federal cannon in the three days of fighting at Gettysburg would last 310 modern guns about seven minutes. When one realizes how close these smaller modern guns are placed when they are in action, one begins to see that they could not be fed at the rate of about 20 shells a minute without light railways. And similarly, the larger guns use fewer shells, but far heavier ones.

The light railway is not the only modern method of transportation that is doing wonderful work directly behind

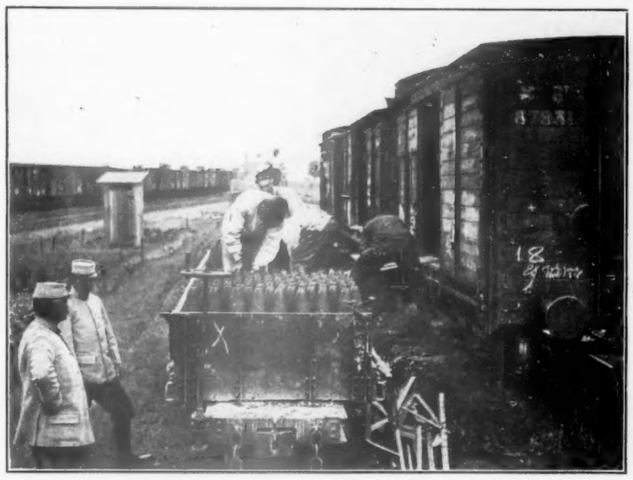


The First Railway in Albania, Built by the Italian Navy

the lines. There is also the automobile truck. The motor truck men are much inclined at times to try to lead one to believe that the motor truck is also fast on its way towards superseding the railway. But while it is, of course, absolutely true that the motor truck has done some remarkable work it is still true that the railway is more than holding its own. And one of the things that is enabling railway transportation to keep its relative importance is the light railway. These lines, to be sure, cannot climb exceedingly heavy grades, and they do have to wait for the construction of some kind of a rail to run on, but they travel with bigger units, thereby requiring fewer men, and the light rails can be laid far faster than a road can be built that is suitable for motor trucks.

How Light Railways Are Built

The usual light railway as used behind the front in France is of 60 c.m. (1 ft. 11⅝ in.) gage. Its rails resemble the A. S. C. E. section 16 and weigh about 20 lb. to the yard. Rails and ties come ready for laying, tangents, special work, turn tables and curves. The tangents come in 1¼, 2½ and 5 metre lengths, fitted with three, five and eight ties respectively. The ties weigh about 20 lb. apiece. The rails can be laid with extreme rapidity in any desirable locality and in many cases, they are even put underground or under the cover of sheltering embankments within a hundred yards of enemy trenches. The little engines are peculiar machines; some of them that have been built in



Loading Shells on a Light Railway Car

America are described elsewhere in this issue. The track, of course, is sometimes very irregular, and the way it rolls and bends is a quick reminder that the lines are military roads, to be operated on the basis not that the track is safe, but that it may be the opposite.

A representative of the British press with the French army has spoken very interestingly of a visit to one of the stations where supplies are transferred from the standard to the light railway: "A military station where the ordinary and the Decauville lines meet behind the front is a curious and interesting spectacle. I visited such a station, which provides for the revictualling of 40,000 men in Champagne. The platform consisted of a long bank raised some 4 ft. above the railway, slimy with mud and covered with what seemed an inextricable mass of carts and horses. A long line of goods trucks had been run in alongside the platform, and every one was hard at work loading the commissariat carts with all that was needed by the troops. As yet wounded men are rarely brought back by the light railways, but special trucks are being prepared for this purpose. The main business of the railway is ammunition and material for the engineers. As soon as the ammunition reaches the station it is immediately loaded on to the Decauville trucks. A small engine is hitched on and the train steams off to an ammunition depot, where the shells are stored in sheds, each calibre of gun having its own particular shed. If word is sent down from the hills in the

north for several thousand rounds of ammunition to be brought up immediately, a little train, with its absurd engine, is summoned by telephone, and is soon in front of the sheds. In a few minutes the trucks are loaded and are off to carry fresh food to the big guns that are pounding at the Germans

A Munitions Station on the Somme

some 15 or 20 miles away. Thanks to organization, not a minute is wasted."

The Great Importance of Light Railways

The light railway helped the French wonderfully at Verdun, where they beat the Germans at their own game. It is helping on the English front, on the Russian front, on the Italian front, and lately has added to its reputation the honor of being the first railway ever seen in mountainous Albania, where the Italians have gone to keep up a line of communications from the Adriatic sea to Salonika.

The importance of the light railway is beyond comprehension to an American who does not realize the stupendous operations on the European fronts. It is not an exaggeration to say that artillery preparation, which is essential to attacks of a general character on trench and other fortified positions would be almost impossible without these lines. The heavier guns, the 420's and the 305's, require broad gage railroads and specially constructed cars to put them

Photograph from Underwood & Underwood, N. Y.

Bridge for a Light Railway Over the Suseiza in Albania

in place some five to fifteen miles from the front, but the narrow gage railroads are used very efficiently to carry the lighter guns into position; and these guns are being used by hundreds. They can also help them change their positions, as is frequently necessary when the opposing artillery observers locate the guns. The engines commonly used can haul a load of 25 tons up a three per cent grade. Some of the cars are so light that they are often moved without an engine.

On the Italian Front

The recent report of the general staff of the Italian army for the quarter, from December to March, cites the usefulness of the narrow gage lines. As an example, the report stated that in a single district 38 locomotives and 1,400 cars averaged a monthly haul of 144,000 tons of material.

Other than its strategic importance with the artillery, the narrow gage line has a vast usefulness in commonplace transportation work. It may be compared in this respect with the army mule whose efficiency has been admired in a dozen wars. It does the heavy, dirty work of hauling supplies, of carting trench dirt, or handling building materials in a way that the road cart or automobile cannot.

One of the advantages of the narrow gage is that it does not demand the right of way on any road. When the weather

Transporting a Heavy Gun

permits, the road along which it is laid may also be used by carts and automobiles.

While the armies of northern Europe have been learning of the importance of the narrow gage as a feeder for the broad gage railroads, the Italians have found a new use for it in Albania. Italian troops, under the direction of the navy, have been operating in this country for practically a year. Albania was a poverty stricken land of no roads of any kind, where even the transportation of infantry on foot was a considerable problem, without speaking of the handling

The Light Railway Keeps Out of Sight

of their supplies, or of the transport of supplies from the base at Vallona on the Adriatic coast. The Italians have put in operation some 60 miles of narrow gage line, and in the wake of the narrow gage have built 180 miles of road for mule wagons. Without the narrow gage it would have been impossible to handle the heavier artillery, or the other heavy materials necessary for a permanent army occupation.

American Railway Labor's Part in the War

By Increasing Its Efficiency It Will Benefit Itself and Help Win Victory for the Nation—England's Experience

THE present war puts upon the railways of the United States the heaviest task and at the same time affords to them the finest opportunity to render a great public service that they have ever had.

The word "railroads" is used here to designate not merely the physical properties of our transportation lines, but rather their organizations. On the organization of a railway principally depends its efficiency. And by "organization" is not meant merely the officials, but also the employees. The railways of this country have about 1,800,000 men on their pay-rolls. Of these, about 16,000 are classified as "officers," and all the rest as "employees." But as a matter of fact, it is impossible to draw a line anywhere, and say that at that line the "officer" class ends and the "employee" class begins. The two classes imperceptibly merge into each other, and, really, all of the members of both of them, from the chairmen of the boards down to the brakemen and the trackwalkers, are employees.

When, therefore, it is said that the way in which the railways will perform the task and the public duty set before them will depend mainly upon their employees, the statement is obviously correct, whether the word "employees" be used in its broad sense, as including all persons on the pay-rolls, or in its narrower sense as meaning all except those belonging to the official class. The 16,000 officers can do much to make the operation of the railways more economical and efficient during the war. But without the most active support and co-operation from the employees they will be unable to cause the railways to render their public service in the way that they ought to.

This being the case, it becomes plain enough that the officials are entitled to receive in this crisis the most and the best work from every employee which he is able to do. For the railways during the war are and will be something more important than merely commercial concerns. They are and will continue to be among the most important instrumentalities for carrying on the war. They will continue to be commercial concerns in the sense that efficient service will be needed from them to enable the country's industry and its workers to continue to prosper; but, in addition, they will be called on to perform functions relating to every activity in connection with the conduct of the war. They must move troops; they must transport munitions and supplies for the troops; they must transport raw materials from which ships, munitions and war supplies are to be made.

Because of the fact that the railways will perform in the conduct of the war a function equal in importance to that of the munitions manufacturing plants and second in importance only to those of the army and navy, their employees will be encouraged to stay where they are rather than to enter the army and the navy on the ground that as railway workers they can contribute more toward the success of the United States in this war than they could as soldiers and sailors.

How Can Employees "Do Their Bit"?

The question naturally arises, as to how railway employees, while retaining their present positions, can contribute most toward the success of military operations. The one way in which they can contribute most is by using all their intelligence, and exerting all the energy consistent with keeping themselves in a healthy condition, to help the managements in their efforts to render the best and the most efficient transportation service practicable. Any railway employee who fails to do this, whether from distrust of or hostility toward the managements of the railways, or from any other cause, will not be loyal to his country; for only by serving the railway as well as he can during this crisis can he serve his country as well as he can.

A majority of the employees of the railways are unorganized, but a large part of them are organized into unions. The degree of efficiency which can be secured from the unorganized employees is largely dependent upon the policy of the managements. The unorganized employees must in the main rely upon the managements for improvements in their conditions of work, advances in their wages, and their promotions, and these things give the officers a degree of control over them which they do not have over the organized employees.

At the same time, it is a fact that the efficiency of the unorganized employees as well as the organized will depend to a great extent upon the spirit with which they are animated. If they do merely what they may consider it necessary to do in order to keep their places and secure promotions in the ordinary course of time, their efficiency will be far less than if they are inspired in what they do by a realization of the fact that they are not doing it merely for themselves or for themselves and the railroad, but for their country.

In order that employees may be given a full understanding of the situation with which the railways of the country are concerned and of the important part which railway employees can and ought to play in helping to deal with this situation, numerous railway managements have called meetings of employees at a large number of points at which ad-

Railway Labor in the War

RAILWAYS must largely increase the useful service they render.

Employes can contribute greatly to this result.

British Organized Labor has set a good example to American Organized Labor.

By increasing their productive efficiency employes will increase general prosperity and help the nation to victory.

dresses on the general situation have been made. In fact, the Railroads' War Board has recommended that "the railroads have meetings at various places all over their systems, so that their officers and employees can discuss the national situation and learn its very great seriousness. The greatest possible interest must be aroused in the proposition of increasing the ability of the American railroads to produce a larger quantity of transportation with the existing facilities. To bring about this all-important result has been put up to every man in railroad service as his supreme patriotic duty."

This is an excellent plan and ought to be carried out extensively throughout the war. It is a remarkable fact that a large part not only of the railway employees but of the people generally of the United States hardly seem to realize as yet that we are at war; that the outcome of the war is by no means certain; that its outcome will be determined by the economic as well as the military exertions of the peoples involved, and that, therefore, whether the side with which the United States has allied itself will be victorious or not, will depend on how men and women in all the walks of life "do their bit."

It would also be a good thing if the managements of all the railways would follow the practice of frequently sending out messages to employees reminding them of the important part which for good or for evil they are playing in the public affairs of the nation, presenting the general situation to them as it develops and recalling to them their opportunities and their duty.

Among the class of railway employees whose highest efficiency in the doing of their work will be most vital in enabling the railroads to render during the war the maximum amount of useful service are the employees in the shops and in train service. Not only is it essential to the economic and military welfare of the country that the trains, and especially freight trains, shall be kept running without interruption, but it is also essential that the maximum amount of traffic shall be handled with every car, every locomotive and every train, and that this shall be done with the least practicable consumption of fuel and other materials and supplies. The extent to which it will be practicable to increase the traffic handled with existing facilities, and at the same time keep down the cost of handling it, will depend mainly upon the efficiency and economy with which the maintenance of equipment, and the making up of trains in yards and their handling on the road, are done.

It happens that a large majority of all the employees in the shops and in the train service are organized and that, therefore, their relations to the managements of the railways are different from those of most of the other employees. The fact that they are organized makes it possible, if they should choose to do so, for them to put greater obstacles in the way of the managements in their efforts to increase transportation efficiency than can be interposed by the unorganized employees, and this very fact imposes upon the employees in the shops and in the train service a greater responsibility than rests upon employees of other classes.

The organized employees have in the past used the power which organization has given them to secure many concessions from the managements, and also much legislation from the state and national governments, which these employees have considered to be to their interests. Not a few of the concessions which they have secured and much of the legislation which they have got passed have been intended to limit the amount of work done by the employees and to cause the employment of men whom railway officials have regarded as unnecessary. Not a few of the practices which organized employees have adopted also have been intended to restrict the product turned out per man and the efficiency of labor-saving machinery.

It is perfectly evident that legislation and practices having these purposes will tend under present conditions to restrict the amount of useful service rendered by the railways per employee, per locomotive, per car and per train. Is it not evident, therefore, that at least during the period of the war, organized railway employees, from patriotic reasons, should assume a different attitude toward matters of this kind from that which they have taken before?

A Good Example From British Organized Labor

If they require evidence of the need for organized labor to do this and precedents for doing it, they can find plenty of evidence and precedents in the countries which were involved in this war before the United States entered it. One of the most illuminating articles that have been written on the labor situation in a country involved in the war is one entitled, "British Labor Under War Pressure," which was contributed to the North American Review for June by Sidney Webb. Mr. Webb is an Englishman, who, while perhaps the highest authority on labor conditions in Great Britain, does not write from the employers' standpoint. On the contrary, he is a socialist and a leading member of the Fabian Society, one of the most famous socialistic organizations in Great Britain. Regarding the attitude of organized labor in Great Britain, Mr. Webb says:

"When it became evident that an enormously increased output of munitions of war was required the trade unions were asked by the government to give up, for the duration of the war, all their rules and customs in any way interfering with maximum production. Without a single exception the trade unions agreed to this request. They formally laid aside all restriction of output; all limitation of the working day; all refusal to work overtime, at night, or on Sunday; all objection to the introduction of labor-saving machinery; all resistance to the admission to their trades of non-unionists, unapprenticed men, laborers, boys, and even women; all opposition to the substitution of piece-work payments for hourly rates, and all reluctance to co-operate in teams as component parts instead of each workman completing his own task.

"They gave up the right to strike and submitted to compulsory arbitration. They even accepted in the Munitions of War Acts of 1915 and 1916, in order to secure continuity of production, the position of being forbidden to leave their employment under a heavy penalty. Never has there been, in any community, a greater or a more complete sacrifice for the common good. The result has been that—at the cost of greatly increased hours of labor and greatly increased strain and effort of the manual workers—the output per operative has, throughout the whole kingdom, by means of a great increase of machinery, been enormously increased.

"By this sacrifice on the part of the British labor movement British manufacturing industry has been, in these two years of war, very largely revolutionized—more completely changed in fact, than at any time since the great industrial revolution of 1780-1825."

How British Labor Prospers

It will be seen that the organized labor of Great Britain for patriotic reasons, already has done all, and even more than all, for the purpose of increasing the productive efficiency of British industries, than anybody would at present think of asking the organized railway employees of the United States to do. There are, however, certain things they have given up which it certainly would not be unreasonable to ask the organized employees of the railways to forego during the war. For example, Mr. Webb says, "they gave up the right to strike and submitted to compulsory arbitration." They also "formally laid aside all restriction of output; * * * all objection to the introduction of labor-saving machinery; * * * all opposition to the substitution of piece-work payments for hourly rates; * * * all resistance to the admission to their trades of non-unionists, unapprenticed men, labor-

ers, boys, and even women." The laboring men of the United States owe as high a duty to their country and are as patriotic as those of Great Britain, and if need be, they surely will go as far as those of Great Britain to increase the productive efficiency of the industries in which they are engaged.

The natural feeling of organized labor may be that if it makes such concessions as have been made by organized labor in Great Britain this will tend to increase the prosperity of capitalists and employers, but may have an opposite effect on labor. Mr. Webb shows, however, that this has not been the effect in Great Britain. He continues:

"Having noted the patriotic efforts of the British labor movement, we have now to record the results of the war on the economic position of the wage-earning class. This war has, at almost all points, baffled the prophets; and in no department have the results been more unexpected than in the economic field. Thus, all previous wars of magnitude have been accompanied by terrible financial suffering among the mass of the people. One of their most frequent results—a social injury enduring for a whole generation—has been the degradation of the standard of life among the wage-earners. The last war waged by the United Kingdom on anything like the scale of the present Armageddon—the Napoleonic conflict that lasted almost unceasingly from 1793 to 1815—reduced the British working-class to a very general destitution, exhausted popular savings, filled the prisons, put 10 per cent of the whole population on the pauper roll, brought down wages to the barest subsistence level, and destroyed for many years every vestige of either industrial or political power among the wage-earning class.

"On the outbreak of the present war many people naturally expected widespread unemployment and distress among practically all the poorer classes. The trade unions, it was said, would soon be bankrupt and powerless. The political influence of organized labor, it was predicted, would be swept aside as completely as its industrial strength. * * * In short, many people looked, on the outbreak of war, for ruin and misery among the mass of the working people. Certainly, no one would have predicted that, after a war of such magnitude and intensity had been waged for over two and one-half years, the wage-earning population of the United Kingdom would find itself, as a whole, actually better off financially than it was in the years of prosperity that immediately preceded the war. Yet (subject to many unfortunate exceptions) this is today undoubtedly the fact.

"In spite of a rise of prices of foodstuffs now approaching 100 per cent; in spite of an average increase in the total cost of living of the typical wage-earning family which may be put at 60 to 70 per cent; in spite of the levy of new taxation on the wage-earning class to the extent, it is estimated, of at least fifty millions sterling (approximately $250,000,000) per annum (in the increase of beer, sugar, tea and cocoa taxes; in the raising of railway fares and postage; and in lowering the level of exemption of the greatly augmented income tax)—there is every sign of the British manual working-class, taken as a whole, being considerably better off in 1917 than in 1913. * * * The total result is that, whilst a considerable number of cases of individual suffering exist, taking the wage-earning population of the United Kingdom as a whole, far from feeling the strain of war, it exhibits today every indication of unparalleled prosperity."

Why War Has Brought Prosperity to British Labor

The connection between the way in which British labor has increased its efficiency during the war, and the fact that during the war British labor has become much more prosperous, is closer than many people, on first thought, will realize.

At the time of the great wars of the past, both the work of production and the work of war were carried on much more largely by mere man-power than is the case now; for it is since the really great wars of the past that most of the labor saving machinery used now, both in industry and in war, has been developed.

Before the use of labor-saving machinery became so extensive, the raising of great armies meant a reduction of productive industry almost proportionate to the number of men taken from industry and converted into soldiers. The industrial and commercial disaster and the general distress which Mr. Webb shows accompanied almost every great war in the past undoubtedly was due mainly to this curtailment of production.

Since the only things there ever are to divide between capital and labor and the only things there ever are for people to consume, are the things which are produced by the joint application of capital and labor, it necessarily follows that every reduction of what is produced must reduce the quantity of things to be divided among the various classes of the community and consumed by them.

Large classes of working people in every country always have looked upon labor-saving machinery as their natural enemy. They have, therefore, in many cases opposed its introduction, and even in more cases have imposed rigid restrictions of various kinds on the output of members of their organizations in using it. The consequence has been, at least until recently, that in no country have there been achieved the great increases in production per capita which labor-saving machinery has rendered possible.

Therefore, when the present great war began there existed possibilities of increased production in most of the countries involved greater than had ever existed at the beginning of any previous war. In the first place, production depended relatively less on man-power, and relatively more on machinery than it ever did before; and therefore, the transfer of a given part of the able-bodied men from industry to war would not, other things being equal, have relatively as much effect on industry as it did in past times. In the second place, other things would not necessarily remain equal, because by removing restrictions imposed by labor union policy, it was possible enormously to increase the productive efficiency of labor-saving machinery and of the labor which operated it.

Now, this is evidently just what has occurred in England. But, obviously, if, say 20 per cent of the workers of a nation are transferred from productive work to military duty, and at the same time the 80 per cent left behind increase their efficiency in production 25 per cent, the total amount of all things produced will be the same as it was before; and in consequence, economically speaking, the war need not have the disastrous consequences resulting from most past wars.

Both the logic of the matter and the experience of Great Britain have a message for the working classes of the United States, including the employes of the railways. That message is, that, on the extent to which American labor increases its productive efficiency and that of the machinery it operates, even though this be at the sacrifice of some labor union principles and practices, will very largely depend the effects which the war will have on the general economic welfare of the people of the country and especially of the working classes.

If total production is maintained or increased, in spite of the number of able-bodied men taken for military service, the war need not destroy or even adversely affect the general prosperity. On the other hand, if total production declines, the effects on the entire American people, and especially on labor, will be disastrous.

But production cannot be maintained or actually increased, in spite of the number of men taken for military duty, unless the labor that remains in industrial pursuits does what the labor of England has done—that is, co-operates with the Government and the managements of the various

industries in increasing to the utmost the productive efficiency of every man and every machine in the country, and this cannot be done unless many labor union rules and practices shall be suspended.

EMPLOYEES, BY HELPNG THE RAILWAYS, HELP THE NATION

The application of all the foregoing to railway labor is sufficiently obvious. While railways and their employees are not engaged in such a directly producing industry as agriculture or manufactures, they are engaged in an industry the utmost efficiency in which is going to be indispensable to the largest production in every other line of industry in the nation. We have seen the productive capacity of manufactures and farms throughout the country restricted during the last year because of the want of adequate transportation. It is impossible under existing conditions, and probably will be throughout the war, greatly to increase the amount of railway facilities. Therefore, if railway facilities are to be made adequate to enable other industries to carry on production to the limit of their capacity, this will have to be brought about chiefly by using existing railway facilities more efficiently than by adding to them.

Will organized labor on the railways help or hinder the managements in their efforts to increase to the utmost the amount of traffic handled per locomotive, per car, per train, per mile of track and per employee? At the present moment this is a question of the greatest importance. On the way in which it is answered by the railway employees will largely depend the success of the railways in performing their part in the war.

It is not to be assumed that in this emergency labor in the United States will show less understanding of the economic questions involved, or less patriotism, than has been shown by labor in England or in any other country. If American railway labor of all classes, realizing the nature of the present crisis, and the part American railways should play in it, will put its shoulder to the wheel as it should, there can be made an increase in the efficiency of railway operation which will set at rest the present grave doubts as to whether the railways will be able to withstand the burdens being put on them.

Fairfax Harrison, chairman of the Railroads' War Board, has summed up the Board's belief in railway employees in the words: "We are relying for results on our belief that the American railroad man is as patriotic as any other, and that he will respond in this national crisis."

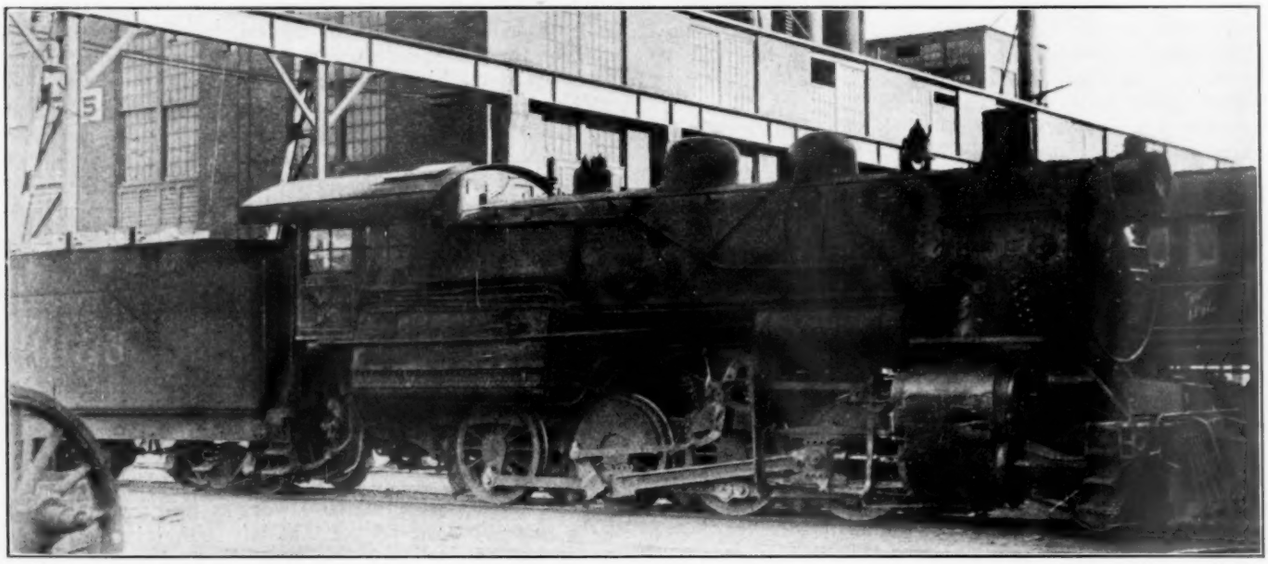


Fig. 1—Appearance of the Locomotive as It was Received at 7 A. M. Monday

Quick Repairs to a Heavy Locomotive

General Repairs Given to a Consolidation Engine at the Colonie Shops of the Delaware & Hudson in 33 Hours

THE Delaware & Hudson, at Colonie, N. Y., made an interesting performance a short time ago in putting a locomotive of the Consolidation type through the shop for general repairs in 33 hours. It was one of a class that was in considerable demand, and in this particular case it was desired to turn the engine out with the least possible delay. In addition to the usual general overhauling, the locomotive was due for its five-year external boiler inspection as required by the Federal government; this requires the complete removal of the lagging.

The locomotive is used in freight service on the Pennsylvania division and is of the following general dimensions:

General

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Anthracite
Tractive effort	56,900 lb.
Weight in working order	257,050 lb.
Weight on drivers	231,550 lb.
Weight on leading truck	25,500 lb.
Weight of engine and tender in working order	389,417 lb.
Wheel base, driving	17 ft.
Wheel base, total	26 ft. 1 in.
Wheel base, engine and tender	63 ft. 1½ in.

Cylinders

Kind	Simple
Diameter and stroke	25 in. by 30 in.

Wheels

Driving, diameter over tires	57 in.
Driving journals, main, diameter and length	11 in. by 17 in.
Driving journals, others, diameter and length	10 in. by 13 in.
Engine truck wheels, diameter	30 in.

Boiler

Style	Wootten
Working pressure	200 lb. per sq. in.
Outside diameter of first ring	82 in.
Firebox, length and width	126⅛ in. by 114 in.
Tubes, number and outside diameter	275—2 in.
Flues, number	38
Tubes and flues, length	14 ft. 6 in.
Grate area	100 sq. ft.

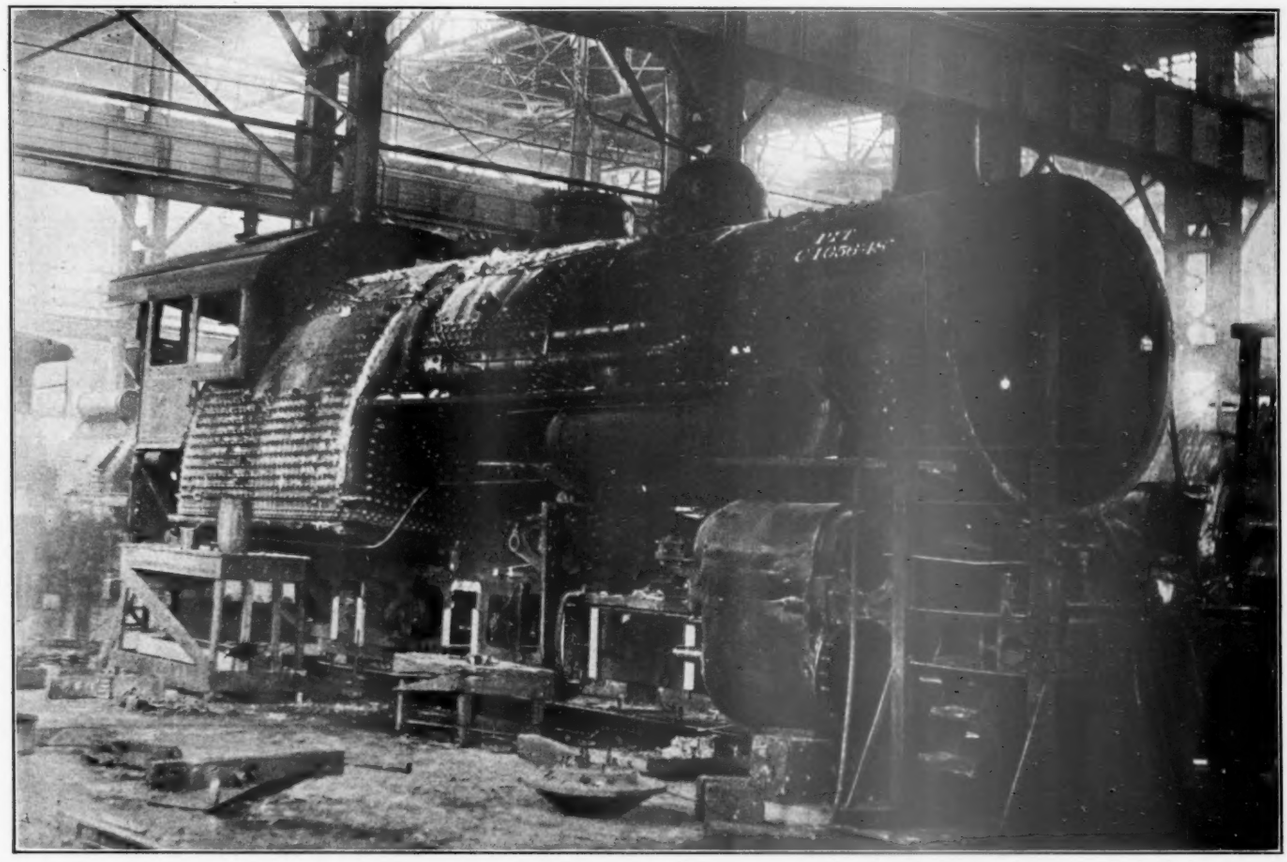


Fig. 2—The Appearance of the Locomotive at 9 A. M. Monday

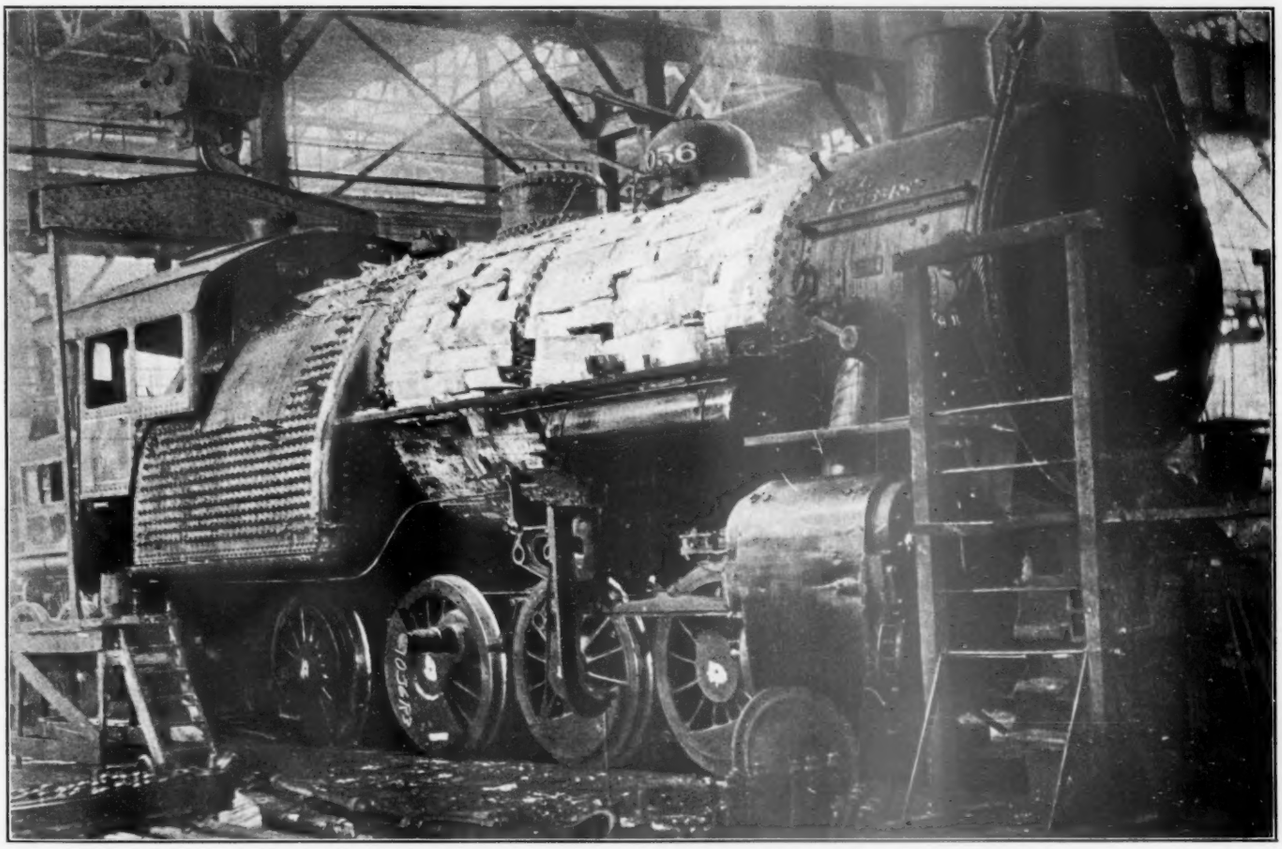


Fig. 3—The Delaware & Hudson Locomotive as It Looked at 1 P. M. Monday

The locomotive was received at the shop cold on a Monday at 7:00 a. m., as shown in Fig. 1, the photograph being taken on the wash track. The following is a schedule of the principal work that was to be done on it:

Full jacket and lagging removal
Tate caps removed of which there were between 1,200 and 1,300
Superheater flues removed
Small tubes rolled and prossered
New shoes and wedges
New driving brasses
Tires turned
Lower guides planed and ground
Crosshead rebabbitted
New rod brasses
Main and side rods and drawbar annealed
Air brake equipment overhauled
Throttle ground

The next picture of the locomotive was taken at 9:00 a. m. of the same day, and is shown in Fig. 2. Between seven and nine o'clock the boiler front and the netting had been removed, the locomotive was completely stripped, the lagging and jacket were removed entirely, the wheels were dropped, the superheater units removed and the boiler was ready for the first test. The valves were also out, the bottom guide bar removed and new shoes and wedges were applied ready to be laid out. Immediately after the superheater units were removed, the work of removing the large superheater flues was begun. The locomotives in the district in which this locomotive operates usually have but very little difficulty with scale in the boiler, but on this particular engine the superheater flues were so scaled that it took until 6:35 p. m. to remove the entire thirty-eight.

The third picture was taken at 1:00 p. m. on the same day, and is shown in Fig. 3. It will be observed that the boiler has part of the lagging applied. The spring rigging was also reapplied. The boiler had been given its test and the wheels applied. The wheels were placed under the engine during the noon hour at a time when the least disturbance would be caused to the rest of the workmen and the crane could be spared best. This work is usually done by the night shift. The practice at this shop is to provide a full set of spring rigging for application to the locomotives as they pass through the shop.

The locomotive as it appeared at 5:00 p. m. on this same day is shown in Fig. 4. The lower guides are back in their place, having been planed and ground, the lagging has been applied and the jacket is in place. The heads of the Tate staybolts have been removed and replaced, and all the staybolts examined. As stated above, the flues were removed at 6.35 p. m. The new ones were applied complete in 1 hour and 25 minutes after the old ones had been removed. During the night the superheater ball joints were ground and units replaced. The front end netting was put in position,

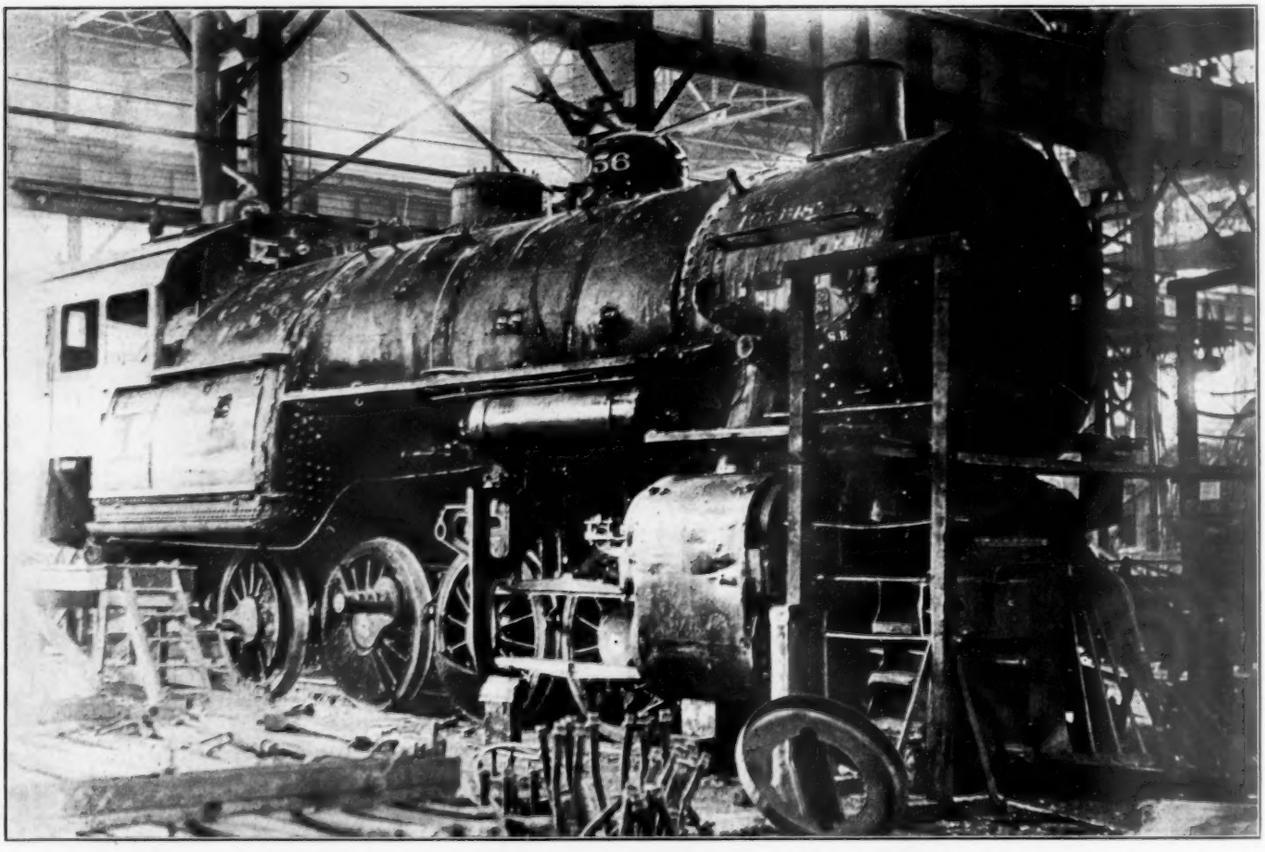


Fig. 4—Photograph of the Locomotive at 5 P. M. on Monday

the side rods were hung and a large amount of the piping was reapplied. The crosshead and cylinder heads were applied. The appearance of the engine at 7:00 A. M. on Tuesday, 24 hours after it had been taken into the shop, is shown in Fig. 5.

The rest of the work was done between 7:00 a. m., when the day force again took the engine, and 12:30, at noon, when it was finished complete, fired up for the testing crew. As will be seen from a close examination of Fig. 5, the work done during this period consisted of applying the main rods, applying the motion work, crank pins, extension piston rods, crossheads and guides, cab fittings, brake connections, pops, etc. The valves were squared by moving the locomotive by a smaller engine. The boiler was washed out and was filled with hot water and fired up in about 30 minutes. The engine was in the hands of the transportation department at

4:00 p. m. on Tuesday, just 33 hours after it was received at the shops. The photograph shown in Fig. 6 was taken when it left the shop. The regular shop forces were used on this engine and a little overtime was paid to get the engine out as soon as possible, but with the night force, which is common to this shop, very little overtime was required.

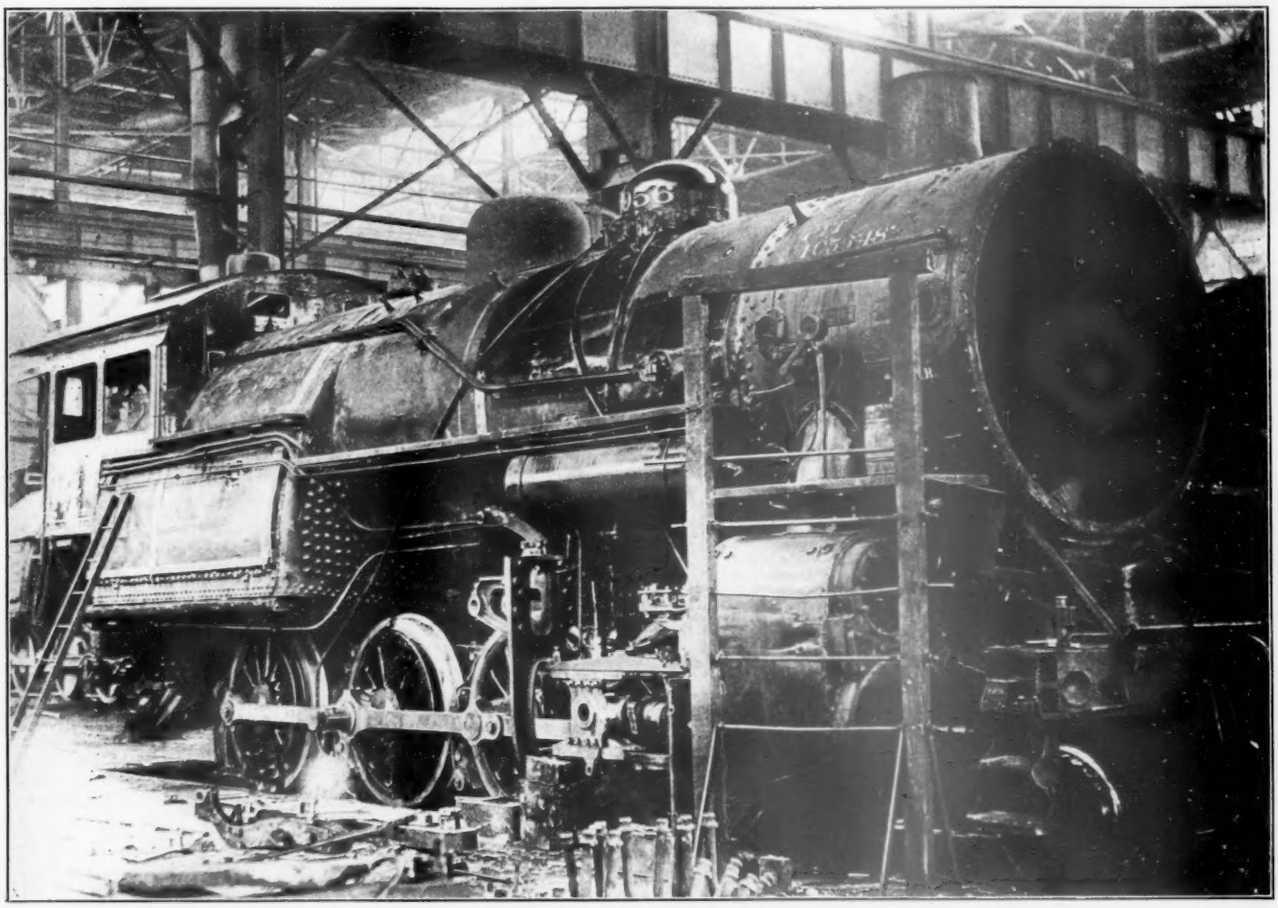


Fig. 5—Condition of the Locomotive at 7 A. M. on Tuesday

The practice at this shop is to have as much of the material ready for application to a locomotive before it comes to the shop. An advance report is submitted for every locomotive so that the material will be ready for application. The shoes and wedges and the spring rigging are made up in advance from new material so that they can be applied immediately. A shop schedule system is used in this shop. The performance described above is a very special case, as it was desired to release the engine as promptly as possible.

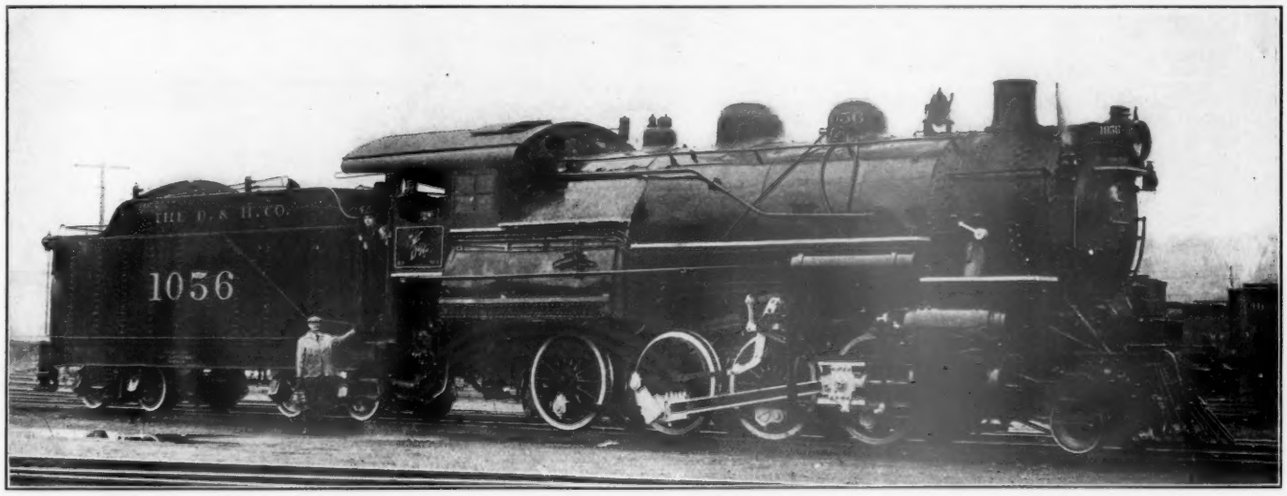
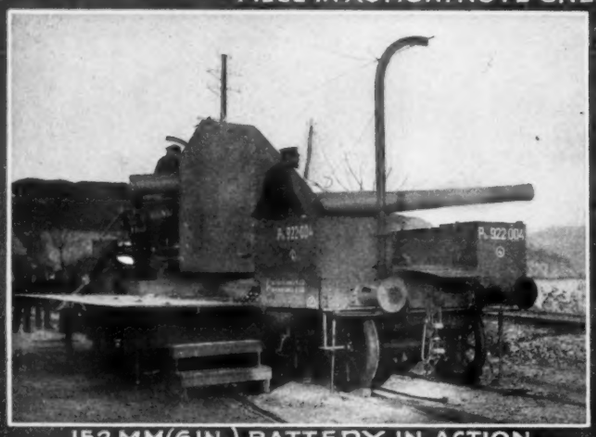


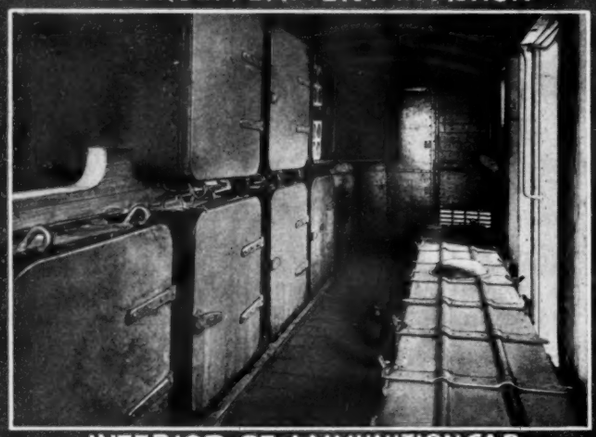
Fig. 6—Completed Locomotive at 4 P. M. Tuesday Ready for the Transportation Department

Preparing material for application in advance has helped a number of shops on other roads to considerably cut down the time that locomotives are in the shop.

PIECE IN ACTION. NOTE SHELL BOXES AT ENDS OF CAR



152 MM(6 IN.) BATTERY IN ACTION



INTERIOR OF AMMUNITION CAR

NEW USES OF ITALY'S ARMORED FORTRESS TRAINS

By Our Special European Correspondent

So successfully have armored fortress trains been used by the Italian navy department for coast defense that these trains are now being built in large numbers for use on portions of the Austrian front.

In a previous article (*Railway Age Gazette,* May 4, 1917) I described in some detail how the navy department had devised these trains for defense against Austrian submarines and aeroplanes attempting attacks against the Adriatic coast. The navy department has now gone a step further and is adopting these trains for offense as well as defense. The photographs, taken of sub-divisions of these trains located along the army front, indicate clearly how useful the Italians have made this method of mounting heavy guns on specially constructed cars and firing them from this position, instead of using the cars merely for the transport of the pieces to permanent locations.

One of the most serious problems in the handling of artillery pieces lies in the fact that the other fellow can shoot too, and sometimes he shoots so well he puts the opposing piece out of commission before it does him much damage. There are two solutions to the problem, first of hiding or screening a piece so well the enemy cannot discover it, and secondly, of rapidly shifting a piece once it is discovered before the enemy destroys it. This problem the railroad has helped to solve.

REAR VIEW OF BATTERY

MOVING 152 MM (6 IN.) PIECE INTO POSITION

Fortress trains were extensively used at Verdun. The scene of operations was gradually covered with a net work of broad gage and narrow gage lines giving eloquent evidence of the growing importance of railroad warfare. The photographic maps of the German trench country, taken from aeroplanes or kites, showed to the French how largely the Germans were using cars as cannon supports, without unmounting them, just as the French were doing.

Since Verdun the practice has become more and more general. In the big battles going on this spring on the Anglo-French front, as soon as a German position is taken the railroad troops move forward, accompanied by automobile trucks laden with rails. They begin making new track connections so the light artillery can be moved forward at once to advanced positions some three to five miles nearer the enemy than their old ones. Anyone who has ever engaged in the moving of a 150 or 205 millimeter gun can understand that if it can possibly be moved by rail not only hours but days and possibly weeks are saved.

The same rail-laying also gains time for the 250, the 305, and the 420 millimeter guns, the jumbos of the lot, inasmuch as they ordinarily take many weeks for shifting. While some of the largest ones cannot possibly be fired from cars, the only way of shifting them is by rail, and tracks are built to their final positions before unloading. They are unloaded upon a regular railroad turn-table, and then slid to a permanent concrete base. When shifting is again necessary, the little railroad is still there, ready for service.

SHOWING CAR SUPPORTS CLOSED

THE LOOKOUT OR SIGNAL MAN

Cultivating the Right of Way on the St. Paul in Iowa.

Railways and Food Problem in the War

Right of Way Gardens, Demonstration Trains, Seed and Labor Bureaus Used to Stimulate Agricultural Yield

THE American railways, which have always been foremost in the agricultural development of the nation, were among the first to recognize the food crisis confronting this country, and they took steps early to meet it. In the event of an indefinite prolongation of the war, the allied countries face a period of privation, if not actual famine. Upon the United States, the great commissariat of the countries at war with Germany, rests the responsibility of keeping herself and her allies supplied with sufficient food in order that the war might be won.

A poor grain crop last year and a poor winter wheat crop this year, together with an increasing shortage of farm labor, necessitate extraordinary efforts to bring about a maximum agricultural yield. In 1916 the production of wheat in the United States fell 386,000,000 bushels below the crop harvested in 1915, a decrease of 38 per cent. The corn crop likewise fell 411,000,000 bushels, or 14 per cent, below that of 1915; oats fell off 298,000,000 bushels, or 19 per cent; and potatoes 74,000,000 bushels, or 21 per cent. The poor results which obtained in this country were paralleled in the rest of the world. Statistics of grain production in the northern hemisphere* show an alarmingly small yield in 1916:

	1916	1915	Deficiency
Corn	2,746,000,000 bu.	3,375,000,000 bu.	629,000,000 bu.
Wheat	2,702,000,000 bu.	3,625,000,000 bu.	923,000,000 bu.
Oats	3,158,000,000 bu.	3,648,000,000 bu.	490,000,000 bu.
Barley	984,000,000 bu.	1,085,000,000 bu.	101,000,000 bu.
Rye	989,000,000 bu.	1,039,000,000 bu.	50,000,000 bu.
Potatoes	1,201,000,000 bu.	1,380,000,000 bu.	179,000,000 bu.
	11,780,000,000 bu.	14,152,000,000 bu.	2,372,000,000 bu.

* Statistics of national and world grain production from a circular published by the Federal Reserve Bank of Richmond, Va., on February 27, 1917. Data for the northern hemisphere do not include the central powers.

Railways Aiding in Farm Production

GRAIN yield in 1916 was abnormally small.

Railroads have called attention extensively to need of increased production.

Many lines have donated their rights-of-way for gardens.

Many have been active in helping farmers to get needed seeds.

Demonstration trains are being run in many territories with excellent effect.

Railways are helping the farmers to get labor.

The recent grain crop in Argentina also was far below usual yields and reports from other parts of the southern hemisphere are likewise discouraging. Winter wheat forecasts in the United States indicate a 1917 crop of about 60 per cent of normal as against 76.5 in 1904, the worst year previously reported. Although the population of the country is estimated to have increased by eight to ten millions from 1911 to 1917, the number of head of livestock raised has increased but slightly and the number of sheep has actually decreased from 53,000,000 to 48,000,000 head.

Calling Attention to the Crisis

Manifestly an emergency existed this spring which demanded that something be done and done quickly. The railways, which have long fostered the agricultural and industrial development of the nation and have literally created inland empires out of wilderness, acted when other agencies were delayed by lack of funds, red tape and cumbersome organization. Shortly after the declaration of war the railroads of the country prepared posters and letters calling the attention of the farmer to the worldwide deficiency in foodstuffs and the imperative need of producing enough in 1917 to tide the nation and her allies over until the next harvest has been made.

The Baltimore & Ohio poster shown in the illustration is typical of the appeals sent out. Many of the placards contained excellent summaries of the situation in a brief and pointed style which could not fail to impress the farmer. The poster shown on the next page, which is distributed by the Chicago, Burlington & Quincy on a large scale, is characteristic.

THE CULTIVATION OF THE RIGHT OF WAY

The railways have not only appealed to the farmer to increase his production, but have offered their rights of way and vacant lands to employees and the public for garden purposes in order to encourage those who have heretofore

INCREASE YOUR PRODUCTION OF ALL FARM PRODUCTS

1. Our Country Needs More Foodstuffs.
2. No Danger of Over-Production.
3. A Great Danger of Under-Production.
4. Supplies of Foodstuffs on Hand Now Are Limited.
5. Our Winter Wheat Crop Is Greatly Damaged.
6. Reports Indicate a Reduced Potato Acreage.
7. Farm Labor Will Be Hard to Get.
8. Demand for All Farm Products Will Be Great—Prices High.
9. Do Your Part to Help Supply This Need.
10. Increase Your Acreage and Production Per Acre—Corn, Potatoes and Grain.

1. Begin preparing your seed bed now. Early work pays. Get rid of weeds.
2. Make your seed bed perfect.
3. Plant seed that you know will grow. Test all seed for germination.
4. Treat potatoes and grain to prevent disease.
5. Practice thorough, clean cultivation throughout the season; get the weeds.

The success of our country in this war depends upon agricultural production. Let us all do our part. Our agricultural department is organized to aid you. We can help you to get good seed, test for germination and treat for disease. We will gladly give you the benefit of our organization and experience.

CAN WE HELP YOU? WRITE TO

J. B. Lamson, *Agriculturist, 547 W. Jackson Blvd., Chicago.*

O. H. Liebers, *Agricultural Agt., 567 Railway Exchange Bldg., Denver, Colo.*

BURLINGTON ROUTE

depended upon the grocer for their vegetable supply to enter the ranks of producers. Farmers also were advised that they might make use of railroad property for the raising of hay and grain. Most of the land was offered free or at a nominal charge to protect the property rights of the company. Complex leases, which hitherto have proved a stumbling block to the utilization of this land on some roads, were simplified. The permit shown above used by the Burlington is typical. Permission to use land requires only the filling in of the form, the signature of the applicant and the approval of a local agent or section foreman of the road.

CHICAGO, BURLINGTON & QUINCY RAILROAD COMPANY

.....1917.

The undersigned, ..., subject to the conditions herein, is hereby granted the consent of the Railroad Company without charge to enter upon a certain parcel of land, constituting part of its right of way near ....., the approximate dimensions of same being.....; for the purpose of cultivation and the growing of food crops during the crop season of the current year.

This license is granted with the express understanding that no land shall be cultivated within 12 feet of the track; that all private crossings over said land of the width of not less than 20 feet are reserved therefrom, and are not to be plowed or disturbed in any way; that none of the fences or gates along the right of way are to be changed, damaged or destroyed in any manner; that all gates used in entering upon and leaving the premises used under this license shall be kept closed; and further that the existing drainage conditions or facilities on said premises are not to be obstructed, damaged or otherwise interfered with.

All are cautioned to exercise the greatest care in entering or leaving the premises of the Railroad Company, and as a condition of the granting of this license the Railroad Company shall not be liable for any injury, loss or damage to person or property from any cause whatsoever, and the said licensee agrees to indemnify the railroad company against all such claims.

Any crop which grows over four (4) feet in height shall not be planted within one hundred (100) feet of any street or highway crossing.

This license expires December 31, 1917.

CHICAGO, BURLINGTON & QUINCY RAILROAD COMPANY,
By E. A. HOWARD,
Vice-President.

Accepted:
.....

Approved:
.....
Agent or Section Foreman.

Some railways have issued excellent booklets on garden culture. Among these is a well illustrated 12-page pamphlet entitled "Grow an Illinois Central Garden," which not only includes suggestions as to the proper planting and care of a garden plot, but also instructions on the canning of vegetables. A somewhat more exhaustive bulletin, entitled "The Vegetable Garden," was distributed this spring by the Baltimore & Ohio. It contains instructions on large scale potato and onion culture, as well as on the care of a family garden. Among the topics covered are seed bed preparation, the amount of seed to purchase, the depth of planting, the rotation of vegetable crops, cultivation, fertilizers, protecting plants from disease and pests, and culture suggestions for different vegetables. The Baltimore & Ohio also distributed bulletins on home canning and the home storage of vegetables.

"Raise potatoes and help to win the war," is the title of a booklet which the Pennsylvania Railroad has distributed among farmers and residents in towns and suburbs along its line. The booklet is a condensation of a special bulletin upon potato culture issued by the department of agriculture of Pennsylvania, and sets forth in simple style the most approved methods followed by scientists and practical growers in producing this crop successfully. The pamphlet was distributed through station agents, division freight agents and the freight traffic department at Philadelphia.

Many roads have made special efforts to induce employees and their families to start gardens. The Buffalo, Rochester & Pittsburgh granted land free of charge to 230 applicants and furnished 1,750 bu. of seed potatoes free to 1,300 employees, in lots not exceeding 1½ bu. each. The Central of Georgia set aside land about three-quarters of a mile from Savannah, Ga., for the use of general office clerks. Seventy employees have so far started gardens which they work in the early morning and late afternoon and on Saturday afternoons. These formed an organization for the purpose of assigning plots, carrying out general work, such as plowing, harrowing, etc., and purchasing tools for general use. The Illinois Central set aside 40 acres of ground adjacent to its tracks at One Hundred Thirtieth street, Chicago, for its employees. The land was plowed and prepared for immediate planting by the railroad and put in general charge of an employee known as the manager of the Illinois Central Employees' Wildwood Gardens.

To give residents along the Chicago, Milwaukee & St. Paul an additional incentive to take up garden plots, A. J. Earling, president of the St. Paul system, personally gave $1,500 for distribution as prizes among amateur gardeners. Of the prizes, $100 will be awarded for the largest yield per acre of any single crop, and a like amount for the best all-round vegetable garden. In addition, prizes of $50 each will be awarded on each division.

It is impossible to estimate at the present time how much railroad property has been put under cultivation, but it will undoubtedly amount to a large acreage in the aggregate. On June 1 the Burlington had granted over 1,300 permits for land, averaging about three-quarters of an acre apiece. On the Iowa division alone, the St. Paul had granted, up to May 24, 125 permits for right of way gardens, some of which are shown in the illustrations. On the Grand Rapids & Indiana 4,500 acres of company land are susceptible of cultivation and on May 23 a considerable portion of this land had already been plowed. On larger roads much greater areas are available; on the Northern Pacific alone nearly 100,000 acres of land were offered to farmers and gardeners. A very large acreage of railway property is available for food production, and if only a small percentage is utilized the results will be appreciable.

The utilization of waste railroad property for the produc-

tion of foodstuffs is not a new idea, as it has been practiced in this country for years. However, the war has had the effect of making more extensive cultivation of unused land imperative, not only in this country but in Europe as well.

Railway Gardening in England

In England the North Eastern Railway has long been a great gardener, and it has done much to encourage the cultivation of its property by employees and the general public. Taking into consideration free right of way gardens, gardens attached to company houses, and fenced allotment gardens for which rent is paid, there are about 10,000 railway men who cultivate plots of land on the system. The management, however, was of the opinion that this was not enough, and in December, 1916, addressed a letter to station masters, agents, yardmasters, locomotive foremen and other employees, which read in part as follows:

"In the case of those who already have plots, we shall be very glad if they can be induced to cultivate a little more; and, perhaps, those who have not in the past done anything in this direction, can see their way to help themselves and the nation by commencing to cultivate now.

"Please also make it known that, subject to the requirements of the company's servants, the company is willing during the present emergency to let people outside the service have free land for this purpose. It is possible that laborers on land adjoining the railway and others might care to cultivate strips inside our fences."

Demonstration Trains

Although American roads have run agricultural demonstration trains over their lines for years, they prepared their tours this year with special reference to the pressing need for more extensive and intensive cultivation. From May 1 to 28, the Los Angeles & Salt Lake sent a demonstration train over its line which stopped at 24 points and was visited by 70,000 people. The tour was arranged and conducted jointly by the Utah Agricultural College, the Universities of Nevada and California, and the Salt Lake route, and had as its slogan, "If you cannot cultivate 10 acres or 10,000 acres, cultivate 10 sq. ft." As one of the urgent necessities of the time is an increase in the production of cereals, one car of the train was devoted to exhibits dealing with soils, irrigation and dry farming in relation to cereal culture. Another car was devoted entirely to forage crops, which was followed by a car showing specimens of high grade livestock and poultry, with models for the economic storage of fodder and the housing of poultry and animals. Another car was devoted wholly to bean culture, with particular information concerning the various types of beans specially adapted to arid and semi-arid lands. Sugar-beet raising was exhaustively treated in a car equipped by the Utah-Idaho Sugar Company, and the combined sugar companies of Southern California. The home economics department of the Utah Agricultural College prepared exhibits in a car devoted to practical means of preserving fruits, vegetables and meats. The United States Government equipped a car which was devoted to forestry and the preservation of cattle ranges. The entire train was illuminated by electricity and many of the exhibits were operated by this power, one car being devoted to electric generating plants, gas-driven motors, pumps and various types of labor-saving devices for the ranch and the home. Accompanying the train were the latest types of tractors and plows, which were demonstrated at each point visited.

The Union Pacific operated a "Farm Preparedness Special" over its lines in Nebraska from May 7 to 12. On the train, which consisted of 7 cars, were 66 lecturers and assistants, representing the Nebraska State Agricultural College and various other institutions. The lectures treated principally of increased crop production, live-stock raising, live-stock diseases, silos and ensilage, feeding, forage crops, potato growing and diversified farming generally. Women lecturers spoke on poultry raising, home economics, cold pack canning of fruits and vegetables, conservation of foodstuffs, gardening and kindred subjects. A total of 218 meetings have been held, with a total attendance of more than 25,900.

The Nashville, Chattanooga & St. Louis conducted a special agricultural tour in Tennessee from April 28 to May 5. The equipment of the train was an auditorium car and a private car for the use of the speakers. The train passed through 21 counties and stopped for 69 meetings, which had a total attendance of 7,109. The subjects discussed related to the general topic of food production and conservation, in line with the President's appeal to the nation, as well as bee-keeping and poultry raising.

Early in the spring the Atchison, Topeka & Santa Fe operated a demonstration train through Kansas. The train stopped at 109 towns during a 30-day period. The tour was devoted particularly to the care and proper feeding of

A Right of Way Garden on the St. Paul East of Perry, Ia.

poultry and cattle, and the grading and proper packing of farm products. Considerable stress was also placed on the food crisis confronting the nation and the need for a maximum agricultural yield in 1917.

The Chesapeake & Ohio ran a farmers' institute train over its lines in Virginia early in the spring. The Virginia department of agriculture furnished a body of trained and experienced agricultural experts to give the farmers definite instructions as to the best and most profitable lines of farming activity in which they could engage, how to keep down disease among stock and ways to eliminate waste on the farm. A representative of the Virginia Farm Loan Board also accompanied the train to inform the farmers as to the best means of financing their undertakings. Meetings were held at 30 points in Virginia, with an attendance of several

One of the Union Pacific Overflow Meetings in a Nebraska Town

hundred people at each. K. T. Crawley, industrial agent of the C. & O., estimates that corn planting in the counties visited will range from 30 per cent to 50 per cent higher than in any previous season, and that the potato acreage has been doubled. Many farmers are also preparing to plow their wheat stubble and sow peas, while others are preparing to plant large crops of late potatoes.

Demonstration Farms Turned Over to Cultivation of Food Crops

To swell the agricultural production of the country, the Nashville, Chattanooga & St. Louis has turned over its 12 demonstration farms, representing 1,763 acres, for the cultivation of food crops. All plans made by the company for experiments in soil fertility, crop rotation, etc., have been abandoned until the close of the war. The Grand Rapids & Indiana also indefinitely postponed proposed experimental plantings at its main demonstration farm at Howard City, Mich., and put in food crops. Its demonstration plot at Big Rapids was turned over to company em-

Photograph by Kadel & Herbert, New York.

Interior of Car on Long Island Canning Special Used for Instructing Housewives How to Preserve Fruit and Vegetables

ployees for cultivation, and a plan for combined experimental and crop production was adopted for its demonstration plot at Cadillac.

Helping the Farmer Secure Labor and Seed

Two serious problems confronting the farmer this spring were high seed prices and a shortage of labor. While other agencies were still planning ways of assisting him, the railroads, with the despatch characteristic of private enterprise, acted. Some roads furnished seed free or on credit to those who needed it. For example, the New York Central Lines, under the direction of F. S. Welsh, agriculturist, distributed over 50 carloads of seed potatoes, mainly to commercial growers and on credit, where necessary. The Chesapeake & Ohio has agreed to provide free alfalfa seed for every farmer along its lines in Virginia, who agrees properly to prepare and inoculate his soil for alfalfa raising. Over 500 farmers so far have taken advantage of the offer.

Exceptionally effective work has been done by the Burlington to secure seed at reasonable prices for the farmers. On May 9, 20 special agricultural agents, recruited from the junior and senior classes of Western agricultural colleges, were sent to various parts of the Burlington system, and the Colorado & Southern lines, in Iowa, Nebraska, Missouri, Kansas, Colorado, Wyoming and New Mexico for the purpose of organizing seed and labor exchanges to assist in supplying the needs of the farms. Each agricultural agent was assigned a special territory comprising a section of the Burlington line, and he organized in each city and town a committee of public-spirited business men and bankers, which constituted a permanent seed and labor bureau. Farmers in contiguous territory were advised by circulars, newspaper and moving picture advertisements and by telephone of the existence of the bureau and its purpose, and were urged to advise the bureau of their surplus or lack of different kinds of seed and their labor needs.

Each permanent bureau chairman was given a list of the names and addresses of other bureau chairmen to facilitate the freest communication between them. Each bureau sends daily reports of its supply and demand for seed and labor to J. B. Lamson, agriculturist of the Burlington at Chicago, and O. H. Liebers, agricultural agent at Denver, Colo., who effect exchanges on the basis of all the information received. A complete list of available supplies of seed and labor is prepared on the basis of these returns and sent daily to each bureau head. The special agricultural agents, who continued their work until June 10, were also personally instrumental in arranging exchanges of seed in the territory in which they traveled. In addition, Messrs. Lamson and Liebers took options on supplies of seed when they could do so advantageously, and held them until they could be disposed of to farmers. Mr. Liebers, in the course of one week, secured 100,000 lb. of beans and 60,000 lb. of seed potatoes, as well as quantities of corn, barley and oats.

A typical example of what has been accomplished in this way is indicated by the fact that Mr. Liebers was able to save the farmers $2.25 a cwt. on one carload of pinto beans, the market price being $16 per cwt. As seed houses have been demanding very high prices this spring, the Burlington has rendered invaluable assistance to the farmers in securing seed at fair prices. In New Mexico a large seed firm, which purchased forage crop seed at from $0.65 to $1.15 a cwt., is now offering the same seed to farmers at from 4½ to 8 cents a pound.

The following is a portion of one of the seed exchange lists prepared by the Burlington for the benefit of the farmers:

SEED EXCHANGE LIST

A portion of the seeds recently located at points along our lines is given below. All seeds listed are known to be on hand at the prices given at the time of making this list. Prices are subject to change without notice however. We urge all those wanting any of the seeds listed to take the matter up directly with the owner at once, as there is a great demand for these seeds and they are being disposed of rapidly. We in no way guarantee any of the parties named in this list.

J. B. Lamson,
Agriculturist.

O. H. Liebers, agricultural agent lines west, 460 Railway Exchange building, Denver, Colo., is in touch with, and has options on large supplies of the following seeds with prices given:

Early Ohio potatoes	$5.00—$5.50 per 100 lbs.
Dry land grown pinto beans	$0.15¾ per lb.
Western dry land corn	$0.03¼ per lb.
Amber cane	$0.06¾ per lb.
Common millet	$0.03½—$0.04½ per lb.
Sudan grass	$0.30 per lb.

The above prices all f. o. b. Denver.

AMBER CANE SEED

Name	Amount	Price
A. R. Kinney, Ravenna, Neb.	75 bu.	$8.50 per 10
H. J. Taylor & Co., Creston, Ia.	10 bu.	Not given
W. J. Farawell, Cumberland, Ia.	10 bu.	Not given
Henry Field & Co., Shenandoah, Ia.	Large supply	Not given
Nishna Valley Seed Company, Hamburg, Ia.	Large supply	Not given

The Burlington has also done much to induce business men and bankers to finance the purchase of seeds for farmers. The business men's association at Alliance, Neb., advanced money for the purchase of seed potatoes on the sole condition that the farmer return the same quantity of potatoes he received when he harvests his fall crop.

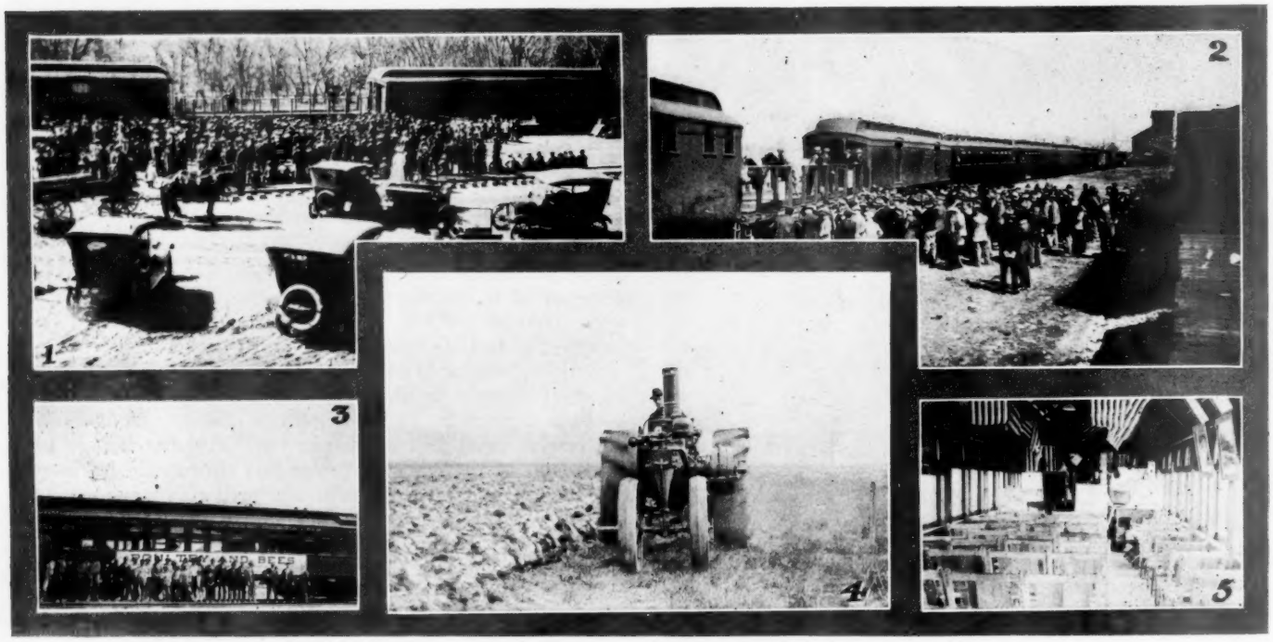
The Burlington has also assisted materially in supplying farm labor. In each community visited, the agricultural agents addressed high school students to induce them to work on the farms. Many schools dismissed those students who wished to take up such work this spring. In Chicago and other large cities the boards of education took an active interest in the farm labor problem by releasing high school

boys who desired to work in the fields. The Burlington has been able to place a considerable number of these boys along its line. It, as well as other lines, has co-operated to advantage with the Chicago Daily News Farm Labor Bureau and the State labor bureaus in the territory it traverses. In many of the communities where Burlington agents have worked, public-spirited business men have established a practice of releasing their employees one or two afternoons each week for farm work.

Other railroads have likewise assisted materially in solving the seed and labor problem. In New York City the Food Problem Committee of the Merchants' Association has co-operated closely with the railroads in assisting the farmer to secure seed, fertilizer, labor and transportation. To increase the number of available farm workers, a census was taken through employers in New York, New Jersey and Connecticut of employees in manufacturing establishments who have had farm experience, and who are willing to work for brief periods on farms during the summer.

The Missouri Pacific, in conjunction with the Missouri State Federation of Commercial Clubs, the Missouri Bankers' Association, and the Governor's Council for Defense, made a similar survey of industrial labor available for agricultural work. The labor needs of the farmers in Missouri were thoroughly canvassed and recorded in card index form, and a like record was made of employees of industries who may be released for short periods for farm work. These surveys have been duplicated in other sections of the country. In Virginia the Chesapeake & Ohio has co-operated with the State Agricultural Council of Safety, organized by the governor to mobilize the food resources of the state, and has placed two of its men at the service of the Council. In each county a sub-committee of the Council was formed, which, with the state organization, assists farmers in securing seed, labor and financial aid to carry on their work.

The Baltimore & Ohio made an exhaustive labor survey this spring under the direction of W. H. Manss, assistant to the vice-president in charge of commercial development. On April 7, 128 representatives of the department were sent over the system to make a detailed survey of agricultural activities, plans for community gardens, and particularly the farm labor situation. Questionaires were placed in the hands of all B. & O. local agents and of influential men in each community for distribution among the farmers so that they could indicate their labor needs. Several thousand of these questionaires were returned to the road, from which information was compiled. On the basis of these returns the passenger department is assisting in supplying labor where wanted. According to the scheme of organization each ticket office has become a small employment bureau for the securing of farm laborers. The questionaire sent out is as follows:



Stimulating the Production of Food Stuffs

(1) and (2) The "Cow and Hen Special" of the Santa Fe Touring Kansas; (3) and (5) Nashville, Chattanooga & St. Louis Demonstration Train; (4) B. R. & P. Tractor at Work Near DuBois, Pa.

THE BALTIMORE & OHIO RAILROAD COMPANY

FARM LABOR REPORT

1. Name of farmer.....
2. Address .....
3. Distance of farm from station.....
4. Number of acres now devoted to each crop, including cereals, forage, vegetables and fruits.....
5. Number of additional acres available for crops if sufficient labor could be secured .....
   Kind of crop best suited .....
6. Number of farm hands you require.....
   For what kind of work.....
   Dates when needed.....
7. Rates of pay per day for labor with board and lodging.....
   Without board and lodging.....
8. Name of Agent.....
9. Station .....

Return to W. H. Manss, assistant to vice-president in charge of commercial development, Baltimore, Maryland.

Another scheme which the B. & O. has worked out to advantage is the organization of an agricultural army. To overcome the prejudice against farm work, resulting from the nature of farm-hand life and the long working hours, the idea was conceived of organizing agricultural units along military lines and of rendering enlistment attractive by making these units a part of the state militia organizations. A soil reserve of this character could recruit large numbers of able-bodied boys below enlisting age, persons rejected by the army for slight physical ailments, and able-bodied men too old for military service. Regular enlisted troops would be suitably uniformed, organized into military units, provisioned, disciplined, drilled, paid and otherwise handled as soldiers. Units could be stationed in various

Views of The Salt Lake Route Demonstration Train

1—A portion of the soils and cereals exhibit. 2—One of the live-stock cars. 3—Where forage crops were demonstrated. 4—A section in the U. S. forestry exhibit. 5—Giant relief map in a section of the government exhibit. 6—Interior of the car devoted to sugar beets and their production. 7—The story of the dry farm. 8—The power car, with its several units in operation. 9—California's bean story. 10—Model of modern ranch equipment. 11—A section of the bean exhibit. 12—In the poultry section. 13—Model of a combined dry farm and irrigated ranch. 14—U. S. exhibit for treatment of hog cholera. Center—The auto has extended the radius from which these trains attract the farmer and his family.

parts of a state where farm labor is needed, to be hired out individually or in squads to farmers to work a given number of hours a day in the raising, harvesting or canning of foodstuffs. The individual trooper would be quartered in the company camp, where he would eat and sleep, and report for military drill after working hours. In order to insure the proper distribution of laborers, individuals or squads could be stationed on the farms to be worked, if located too far from camp to permit walking back and forth. It would be necessary, of course, for the men to report at camp Saturday evenings and Sundays for military drill, lectures, etc. The Baltimore & Ohio has already organized two agricultural units, which are now at work in Maryland, and it is hoped that they will receive official recognition as a part of the militia from the state legislature, which will soon meet in special session.

Realizing that the shortage of labor along its line would militate against a material increase in food crops, the Buffalo, Rochester & Pittsburgh purchased three farm tractors and three gang plows for the use of farmers on the basis of the actual cost of operation. The tractors have been used constantly and plow and harrow as much as 20 to 25 acres daily. They use kerosene for fuel, consuming about three gallons per acre plowed.

FEED THE PEOPLE
JOIN THE AGRICULTURAL ARMY
Do your part by using every available foot of ground for the production of staple foods.
Raise Corn, Potatoes, Tomatoes, Onions, Beans, and other farm products.
By so doing you will show real patriotism and help solve the food problem.
THE
BALTIMORE & OHIO
Railroad in a neighborly spirit, through its
COMMERCIAL DEVELOPMENT DEPARTMENT
makes this appeal to the public.
WILL YOU HELP?

A Poster Issued by the Baltimore & Ohio

Some railroads have given their employees company time in which to do farm work. The Texas & Pacific recently instructed all of its section and machine shop foremen to place in immediate cultivation all the available space along the right of way. In order to provide an adequate supply of labor, each section man and machine shop employee is given one-half day a week of the company's time to perform this work. A number of roads have gone so far as to offer to loan part of their section laborers to farmers along their lines in order that they might have sufficient help during the planting and harvest season.

Introduction of Better Seed, Fertilizers and Improved Farm Methods

The railways have been active in promoting heavier production and crop conservation by the introduction of better seed, fertilizers, and improved farm methods. The Atchison, Topeka & Santa Fe, for instance, started a campaign in Kansas last fall to bring about a larger production of wheat per acre. Arrangements were made with millers whereby farmers could secure selected wheat seed, properly cleaned and treated for smut, in exchange for their own wheat. By means of this plan, 50,000 acres were planted with better seed. It is estimated that this will result in an increased production of at least two or three bushels an acre. If the same scheme were applied to the entire state of Kansas, with a normal wheat acreage of about 10,000,000, it would result in increasing the production of wheat in that state by 30,000,000 bu. a year.

The New York Central lines have consistently encouraged the extensive use of ground limestone in sections where the acidity of the soil shows need of it. Many farmers are not located where it is possible to get burnt lime at a reasonable cost, while ground limestone can be shipped to them at an average cost of about $3 per ton. In some instances it has been necessary to encourage the erection of plants for grinding limestone in communities somewhat distant from available supplies.

The Atlantic Coast Line, in conjunction with the United States Department of Agriculture, has been instrumental in disseminating information regarding the proper curing and warehousing of sweet potatoes. Because of the antiquated method of storing in earthern banks, it is estimated that 30,000,000 bu. of sweet potatoes were lost last season. The Seaboard Air Line has also urged successfully the erection of proper storage plants for sweet potatoes, as well as for corn and beans. In addition, it has induced a number of communities to build plants for the grinding of peanuts and soy beans. Oil mills which heretofore have used cotton seed exclusively have been persuaded to grind soy beans and peanuts as well.

Railroads Encourage Stock Raising

The railroads have not only assisted in solving the farm labor and seed problem, but have fostered the raising of live-stock. A number of western lines have been successful in conserving calves from slaughter by effecting their transfer from farmers who cannot afford to raise them to those who can. They have also induced bankers and prominent business men to finance those not able to purchase calves. Children have been organized into calf clubs for the purpose of encouraging the raising of young stock to maturity. For years a considerable number of roads have made a practice of securing pure-bred bulls and placing them in various communities for the free use of farmers. This work has been intensified since the declaration of war. The erection of silos has been persistently urged so that forage can be stored economically for the feeding of cattle.

In large sections of the West the spring forage crop was a failure, and as a result fields containing these crops were plowed up in many instances and put into corn or grain. The railroads did much to induce farmers to replant forage crops and to breed sows for fall litters, thereby conserving the swine from slaughter and insuring a substantial increase in the hog supply this fall.

The New York Central lines are planning to secure 30,000 sheep from the western ranges for distribution in New York. The first lot of 10,000 will be placed on farms in the neighborhood of Albany, which have been fenced in for the purpose.

The Missouri Pacific discovered this spring that large numbers of sheep raisers in the West were disposing of their flocks because of the belief that they would be dis-

possessed of their ranges by the 640-acre homestead act passed by Congress. B. F. Bush, president of this road, and D. C. Welty, commissioner of agriculture, communicated with the United States Department of Agriculture to learn whether the date for putting the act into effect could not be postponed for a few years in the interest of sheep conservation. D. F. Houston, secretary of agriculture, replied that the act was misunderstood, and that it would not go into effect for a year or more. The substance of his letter and a letter along the same lines from Carl Vrooman, assistant Secretary of Agriculture, was placed before A. C. Bigelow, president of the Philadelphia Wool and Textile Association, and W. W. Burch of the National Sheep and Wool Bureau, Chicago, so that the matter could be given the widest publicity.

In a circular letter recently sent to farmers along the Illinois Central, T. J. Foley, general manager, pointed out the great loss in stock killed on the lines of the system, and asked that all concerned co-operate to prevent this waste. During the last five years, he said, there have been killed on the tracks of this system 5,122 head of horses and mules, 16,121 head of cattle and 11,526 head of hogs. The average number of head of cattle killed per year on the way lands of the Illinois Central, during the last five years, was 3,224. Assuming that the average weight of these animals was 800 lbs., the loss in beef was 4,098 lb. per day, as the average animal will net 58 per cent in dressed beef. The average number of hogs killed per year was 2,305. Figuring the average weight per hog at 100 lb., the loss was 473 lb. of pork a day, as hogs net 75 per cent in dressed meat. This loss in cattle and hogs combined constitutes a waste to the nation of 4,571 lb. of meat per day, which is sufficient to sustain approximately 5,000 people.

Many roads have specially cautioned their employees to give the proper care to food in transit to prevent unnecessary loss. J. F. Murphy, general manager of the Missouri Pacific, on May 5, sent a circular to all officers and employees on this subject. The circular reads in part as follows:

"The food supply of the nation is committed to the care of the railroads for transportation, and each employee should bear in mind that he can perform no duty more patriotic at the present time than to make every effort to see that the shipments, in the transportation of which he has a hand, are handled without loss or damage. Every sack of flour that is damaged by rough handling or improper preparation of the car, every bushel of wheat that is lost by defective equipment, every shipment of perishable goods that is spoiled by delay, improper refrigeration or ventilation, every animal that is killed on the right-of-way, and every pound of shrinkage caused by stock being delayed or injured by rough handling, hampers our country in its effort to conserve its resources during this international conflict."

The Railroads and Mineral Fertilizers

In addition to the substantial assistance which the railroads have given the farmers and the nation in working for an increased agricultural yield, some railroads through their mineral resources departments have aided in promoting the exploitation of heretofore unused mineral deposits available as agricultural fertilizers. Before the war potash was imported from Germany and the cutting off of that supply proved serious for some American farmers. The industrial department of the Atchison, Topeka & Santa Fe, which maintains a bureau on mineral resources in charge of W. P. Matchette, industrial agent, was instrumental in finding beds of kelp near San Diego, Cal., which were more easily accessible than other beds along the coast, and interested Swift & Co., Chicago, in utilizing them for the production of potash.

Although not directly pertinent to agriculture, it is worth noting that the Santa Fe was also instrumental in interesting steel manufacturers in deposits of manganese on its lines in Arizona and New Mexico, which had remained undeveloped before the war because of water competition with the imported product. Considerable manganese is now being mined at points on the Santa Fe, and is being utilized in the manufacture of high grades of steel. The Santa Fe also promoted the development of deposits of magnesite, formerly imported from Austria and Greece. Magnesite is used for the lining of steel furnaces.

The extensive development work which has long been carried on by railroads for the admittedly selfish purpose of creating new traffic and, incidentally, increased revenues for their lines, enables them in the present emergency to give substantial assistance to the nation when increased food production is a prime necessity. What the railroads have done for years by means of demonstration trains, demonstration farms and permanent staffs of agriculture experts to foster the production of foodstuffs has this year been intensified with excellent results. In general, the railroads are utilizing every resource at their command and are co-operating with all agencies working to the same end to make food preparedness an actuality and not a mere desideratum.

Small Locomotives Used at the Front

A Description of Some of the Small Engines Used Near the Firing Line for Handling Troops and Supplies

THE mobility of the armies and the rapidity with which supplies can be brought to the front have been important factors in the war. When the war first broke out in 1914 motor driven vehicles were commandeered indiscriminately throughout France. It was believed that these vehicles would offer an ideal means of quickly transporting troops from one point on the front to another. It was soon found, however, that this means of transportation presented serious difficulties. Automobiles are extremely hard on dirt made roads and with the large amount of traffic that was conducted over them, the roads soon got into very poor condition. This necessitated expensive repairs.

Another difficulty encountered in the use of automobiles was in establishing a road around a wrecked car, and in despatching the cars to and from the front over the different roads, there being so many individual units. It was soon determined that steam railway communication was necessary for carrying the troops and supplies for the bulk of the distance. With a properly organized force, suitable tracks for the narrow gage trains used for this service could be quickly laid, removed and relocated. This required a large number of locomotives, many of which were built in this country.

The Baldwin Locomotive Works has furnished 2,219 locomotives for this purpose to England, France and Russia. Of these 1,421 were built for service at and near the front and 798 for standard road service. The 1,371 locomotives were divided into classes as follows:

No.	Type	Size cylinders	Gage	Where used
32	0-6-0 Tank	9 in. by 12 in.	1 ft. 11⅝ in.	France
280	0-4-4-0 Tank (Pechot)	6.9 in. by 9.45 in.	1 ft. 11⅝ in.	France
506	4-6-0 Tank	9 in. by 12 in.	1 ft. 11⅝ in.	France
8	0-4-0 (Fireless)	15 in. by 16 in.	4 ft. 8½ in.	France
350	0-6-0 (Gasolene)		2 ft. 5½ in.	Russia
70	0-4-0 Tank	14 in. by 22 in.	4 ft. 8½ in.	France
50	2-8-0	21 in. by 28 in.	4 ft. 8½ in.	France
75	2-6-2 Tank	17 in. by 24 in.	4 ft. 8½ in.	France
50	0-6-0 Tank	16 in. by 24 in.	4 ft. 8½ in.	France

This list of locomotives is given approximately in the chronological order of their purchase, the order for the first 0-6-0 tank locomotives being placed in November, 1914. These locomotives were patterned after those built by the Baldwin Locomotive Works for the Japanese government at the time of the war with Russia in 1904. They were the first locomotives to be used in trench warfare and for the want of a better design were first used by the French government. These locomotives were constructed in record time. The order for the first 20 was received on the afternoon of Tuesday, November 3, 1914. The first boiler was completed on November 10, at 11:00 a. m.; one of the locomotives was entirely finished on November 13, and at 11:35 a. m. on November 21, the last engine, completely boxed, left the works. The 20 locomotives were thus completed in 16 working days.

These engines are wood burners, equipped with Radley and Hunter stacks and in general design follow American practice closely. The equipment includes a steam brake with auxiliary hand gear. Twelve duplicates were ordered in March, 1916. The principal dimensions of these locomotives are as follows:

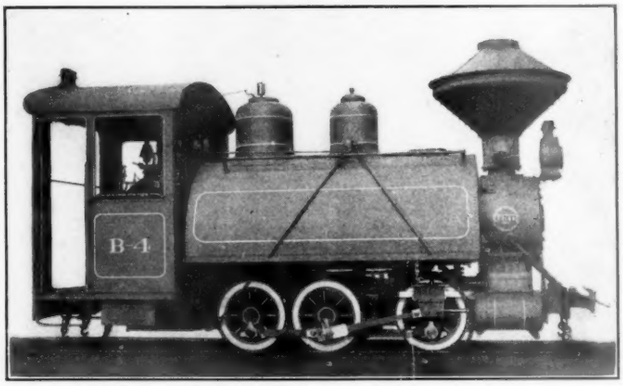
Gage	1 ft. 11⅝ in.
Fuel	Wood
Cylinders	9 in. by 12 in.
Boiler diameter	31 in.
Boiler pressure	165 lb.
Size of firebox	30 in. by 27⅜ in.
Number and size of tubes	83—1½ in.
Length of tubes	8 ft. 3 in.
Total heating surface	295 sq. ft.
Diameter of driving wheels	26 in.
Wheel base	5 ft. 8 in.
Weight on drivers	29,000 lb.

These locomotives were used in the roughest kind of service and over rails that were frequently relocated. The roadbed was therefore not of the best. It was found that the center of gravity was too high and the wheel base was too short for use under these conditions without numerous derailments.

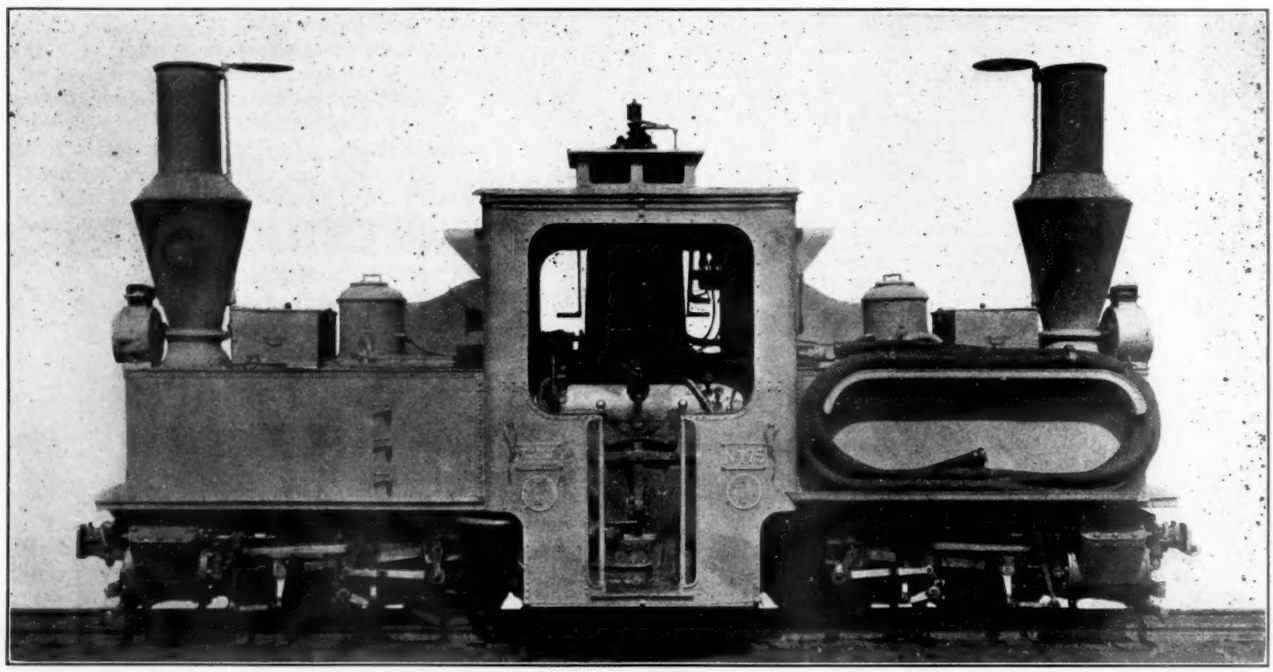
The next design considered for this service was the Pechot locomotive. These are practically duplicates of those built in France in 1888 for military purposes. They are of French design and were built to rigid specifications. They are admirably fitted for trench service as they are flexible, have a low center of gravity, and with but little overhang at either end ride steadily on uneven tracks. A total of 280 have been built by the Baldwin Locomotive Works and all were constructed to metric system measurements. The first consignment of 100, ordered February 1, 1915, was entirely completed by April 24 of the same year.

The locomotive is carried on two steam-driven trucks or bogies, as shown in the illustrations. All four cylinders receive high pressure steam and the distribution is controlled by circular balanced slide valves operated by the Walschaert valve gear. The four gears are controlled simultaneously by means of a hand lever. The live steam pipe leading to each pair of cylinders passes down through the center pin of the corresponding bogie and the ball joint in the pipe can thus be arranged to coincide with the center on which the bogie swivels. Normally, steam is admitted to all four cylinders simultaneously, but the throttles are so arranged that, if desired, the locomotive can be driven by one bogie only.

The boiler has a smokebox and stack at each end and is built with two independent fireboxes and groups of tubes, which have a common outside shell with one large steam space. The shell plates are of steel, while the fireboxes are



Saddle Tank Locomotive Built in 1914 for Use in France



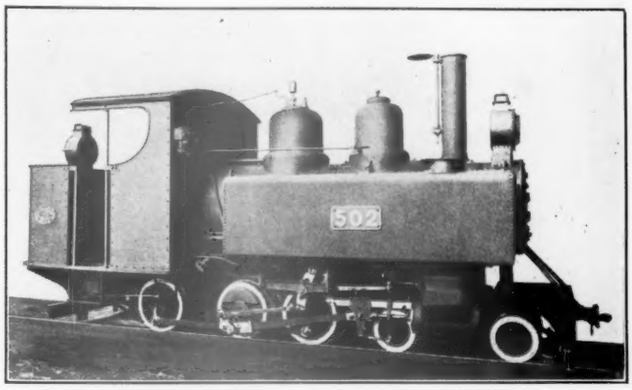
Pechot Locomotive Used in French Service

of copper and the tubes of brass. The fireboxes are centrally located between the bogies. The boiler barrels are supported on saddles placed above the bogie center pins and the outside firebox shell is supported in a cradle, consisting of two plate frames which are riveted to the saddles. It is necessary with this construction to attach the firebox shell rigidly to the frames and make provision for expansion and contraction by allowing the boiler barrels to slide on the saddles.

These locomotives were given severe running tests on a track specially built for the purpose. They ride with little vibration as the weight is transferred to the bogie center pins through heavy rubber washers and the side bearings are also of rubber. While the design, when compared with American locomotive practice, appears rather complicated, the engines are undoubtedly well fitted for their work and prove efficient machines in the hands of an organization which is trained to care for them. They will carry a large number of men on the running board which extends completely around the locomotive. The important dimensions follow:

Gage	1 ft. 11⅝ in.
Fuel	Soft coal
Cylinders	6.9 in. by 9.45 in.
Boiler diameter	24.9 in.
Boiler pressure	171 lb.
Size of firebox (length and width)	16.3 in. by 22.7 in.
Number and size of tubes	96—1¾ in.
Length of tubes	68.5 in.
Total heating surface	281 sq. ft.
Diameter of driving wheels	25.6 in.
Wheel base (total)	12.5 ft.
Wheel base (rigid)	35.4 in.
Weight on drivers	28,100 lb.

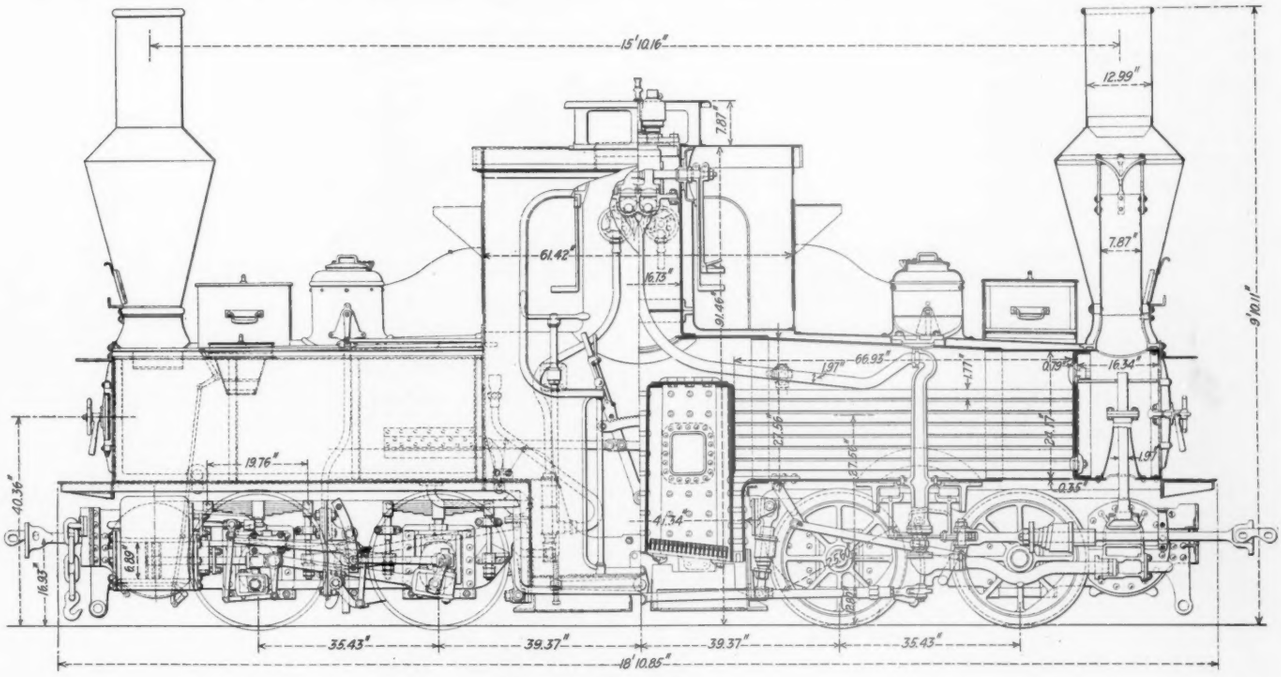
The first order of 4-6-0 tank locomotives was constructed in January, 1915, for the French government for use in Morocco. In the latter part of the same year 495 were built for the British government for trench service in France. These are somewhat heavier in total weight than the Pechots, but carry less weight on driving wheels. In general, the design follows American practice, although such features as copper fireboxes, brass tubes and cabs of distinctly foreign pattern are to be noted. The frames are of the bar type and the steam distribution is controlled by plain slide valves which are driven by Walschaert valve gear. The engine truck is of unusual design. Each side frame is cast in one piece with its adjacent boxes and the frames tied together at the ends by transverse rods. The cast steel transom is pinned to the side frames and supports a swing bolster through two links placed on the center line of the locomotive. The weight is transferred to the bolster through a coiled spring, which serves the purpose of a center pin as well as providing the necessary elasticity.



Narrow Gage Ten-Wheel Tank Locomotive Built for the British War Office

The more important dimensions of these locomotives are as follows:

Gage	1 ft. 11⅝ in.
Fuel	Soft coal
Cylinders	9 in. by 12 in.
Boiler diameter	33 in.
Boiler pressure	178 lb.
Size of firebox (length and width)	29⅞ in. by 27⅝ in.
Number and size of tubes	83—1½ in.
Length of tubes	7 ft. 2 in.
Total heating surface	254.5 sq. ft.
Diameter of driving wheels	23½ in.
Wheel base (total)	12 ft. 4 in.
Wheel base (rigid)	5 ft. 10 in.
Weight on drivers	23,250 lb.

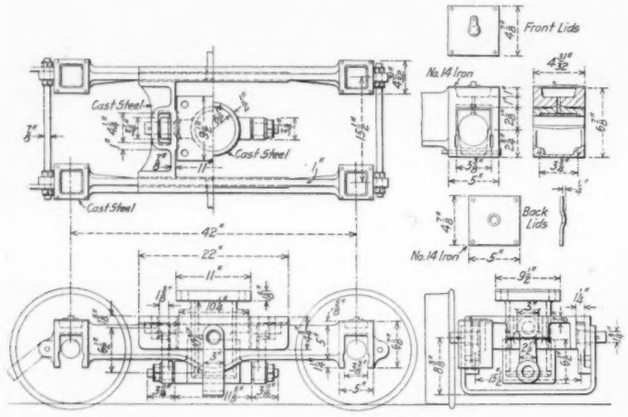


Elevation of the Pechot Locomotives

One of the most interesting types of trench locomotives built by this company is the gasolene engines supplied to the Russian government. In many respects, this type is specially well suited to military service. With no boiler, it can easily be handled by one man and there is no smoke to betray its presence to the enemy. These locomotives, with

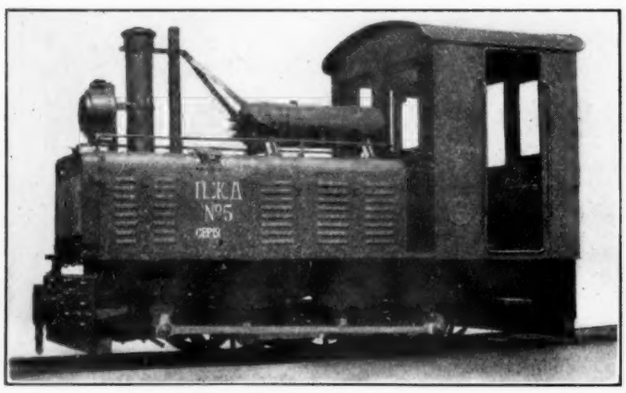
six wheels and a weight of only 15,000 lb., can be safely used on light tracks and the wheel loads are equalized as in a six-coupled steam switching locomotive. Instead of a Scotch yoke side rod connecting the jack shaft with the wheels, as in Baldwin four-coupled gasolene locomotives, the jack shaft in this design is connected to the rear pair of wheels through long connecting rods and the wheels are coupled by separate side rods. The frames are steel castings of the bar type, and heavy transverse timbers at each end, placed at a low elevation, serve to protect the machinery and running gears from damage in case the locomotive is derailed.

In the early part of 1917 eight fireless locomotives were



Truck of the British Ten-Wheel Tank Locomotive

built for the French government, presumably for use in and about places where the fire hazard was great. They are built to standard gage, have 15-in. by 16-in. cylinders and 30-in. drivers, weigh 42,750 lb. and have a wheel base of 5 ft. 6 in. They were designed to make a run of 6.2 miles on one charge of the reservoir, hauling a load of 80 tons up a grade of 0.4 per cent. The reservoir is designed to carry 208 cu. ft. of water, with a steam space of 52 cu. ft. The storage pressure is 170.6 lb. and this is reduced to a cylinder working pressure of 50 lb. The equipment of these loco-

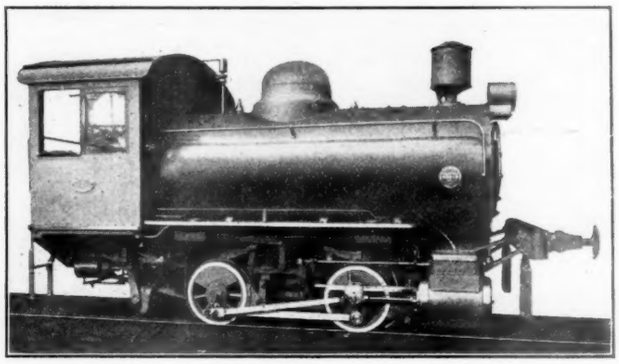


Gasolene Locomotive Built for Russia for Use in the Vicinity of the Firing Line

motives includes combined steam and hand brakes, also a storage battery for supplying current to the electric headlights.

Other standard gage locomotives built for the British government for use in France include seventy 0-4-0 tank locomotives weighing 78,100 lb., fifty 2-8-0 type locomotives weighing 162,510 lb., seventy-five 2-6-2 tank locomotives weighing 150,900 lb. and fifty 0-6-0 tank engines. In these locomotives the weight per driving axle is in the neighborhood of 38,000 lb. The equipment is generally similar and the materials conform to specifications issued by the American Society for Testing Materials. With the exception of a few details, the locomotives conform to the designs commonly used in America.

The Consolidation locomotives use saturated steam and are equipped with piston valves driven by the Walschaert gear. They exert a tractive effort of 35,600 lb. so that they are admirably fitted for heavy road service. They are to be used where the track conditions are poor and as the rails are frequently covered with greasy mud, provision is made for discharging hot water and steam on the rails at either end. A portable water lifting equipment is provided with a suitable steam valve in the cab, so that water can be picked up from alongside the track. For this reason it may frequently be necessary to use water of inferior quality, hence the boiler is provided with unusually ample wash-out facilities. The equipment includes Westinghouse combined automatic and straight air brakes, also steam heat. The



Standard Gage Fireless Locomotive Built for the French Government

tender is carried on two four-wheel trucks and with the exception of the coupling devices, is similar to the tenders used in this country.

The 2-6-2 type locomotives exert a tractive effort of 24,120 lb. and are equipped with Stephenson link motion and balanced slide valves. They are of compact design, and while primarily intended for switching service, they can also be used for road work where the runs are comparatively short.

While there is no authentic information regarding the service in which these locomotives are to be used in France, they are of such design that at the close of the war they can be used in regular railway service if they have not been used beyond the point at which they can be repaired at a reasonable cost.

The packing and shipping of all these foreign engines involved a large amount of difficult work, and was complicated by reason of the many domestic orders completed during the past year. With the exception of the Consolidation and the 2-6-2 type tank locomotives for the British government, the large engines were all erected at Eddystone. This was also the case with the Pechot locomotives and the Russian gasolene engines, which had to be tried out on special tracks provided for the purpose. Ample space was available at Eddystone for laying out these miniature railways. The 10-wheel tank locomotives for the British government were erected at the Philadelphia plant and were tried under steam by mounting them on rollers. The large locomotives were, of course, dismantled and packed in the usual manner, but the small ones were each shipped complete in one case, ready to be placed into service immediately upon arrival at their ultimate destination.

Military Bridge Over the Cumberland at Chattanooga

Use of Railroads in War an American Development

The Basic Problems of Railway Transportation in War Time First Found Solution During the Civil War

IT is fitting that the American railways through the Railroad's War Board and its many committees should have been among the first of all our industries to put themselves in readiness for united action in the conflict in which America is now engaged. The American railways have an honorable record to sustain, for it was our railways that taught the railways both of our allies and our enemies how to engage in military transportation.

That it should have fallen to America to do this teaching is due partly to American ingenuity, but mostly to our Civil War, for it was in that great conflict that the railways of any country first had extensive experience in assisting armies in the field. The Civil War, like every great war, evolved many principles of military science, and among the most important were those relating to railway transportation. The methods that were so successfully worked out then of handling soldiers and supplies over distances, long and short, are the basic method in use in Europe today.

THE RAILWAYS IN THE CIVIL WAR

In 1860 the total mileage of railways in the United States was only 30,626. These railways were divided into a multitudinous number of small and more or less disconnected systems and were not even all of standard gage. During the war no attempt was made to co-ordinate all these lines as has been done through the Railroad War Board today, although a large mileage of railways directly in the zone of war were taken over by the government and operated directly as military railways under the name of the Military Railroads of the United States.

FAMOUS RAILWAY OFFICERS IN THE CIVIL WAR

There were several railway officers whose names stand out in the story of the Civil War. One of these is Thomas A. Scott, vice-president of the Pennsylvania Railroad who was called by President Lincoln at the outbreak of hostilities and made practically dictator of railways and telegraphs. Mr. Scott was later assistant secretary of war, but resigned June 1, 1862, to return to railway service, and after the war became president of the Pennsylvania System.

D. C. McCallum, general superintendent of the Erie, was called upon in February, 1862, to be military director and superintendent of railroads in the United States. He served for many months with the rank of colonel, was later appointed general manager of all the military railways in the departments of the Cumberland, the Ohio and the Tennessee and of Arkansas, forming the military division of the Mississippi, and at the close of the war had the rank of brevet brigadier general.

Herman Haupt, an eminent railway engineer and West Point graduate, served for many months as chief of construction and transportation of the United States Military Railroads, but returned to private life before the war was over, having first been made a Brigadier General of Volunteers.

Another name that stands out prominently is Samuel Morse

American Railways in War

THE railroads of the United States were the first to be used extensively for military purposes.

During the Civil War 2,105 miles of line were operated as military railroads.

The problems of authority over railway operation in a zone of hostilities and of railway construction and destruction incident to an army's movements were worked out on these roads.

It was here first shown that railways used in war must be operated by railway men. Railways outside the war zone also had many problems to meet. They were badly handicapped by labor shortage.

Felton, president of the Philadelphia, Wilmington & Baltimore. Mr. Felton continued as president of that property throughout the war and as its chief executive had much to do with the splendid part that railway played in the great conflict.

The United States Military Railroads

At the outset of the war, the government at Washington took possession of the Philadelphia, Wilmington & Baltimore, but only as a temporary measure. In January, 1862, the President was authorized "when in his judgment the public safety may require it," to take possession of any or all the railroad or telegraph lines and to operate them "in the manner most conducive to the safety and interest of the government."

Under this act the President took over only 2,105 miles of railway, all in or near the field of action. Even the Baltimore & Ohio, the Northern Central and the Cumberland Valley, although they were visited several times by enemy troops and were essential lines of communication for the northern forces were never taken over, the President realizing that their own officers knew how to secure the best results in operating them.

Under the authority of the act, however, D. C. McCallum was called upon to be military director and superintendent of railroads in an order issued February 11, 1862.

The Military Railroads of the United States in the Civil War

Railroads in Virginia, Maryland and Pennsylvania

	Now part of—	Miles Used.
Alex. & Washington	Phil., Balt. & Washington	7
Alex., Loudon & Hampshire	Southern	15
Orange & Alex	Southern	68
Warrenton Branch	Southern	9
Manassas Gap	Southern	62
Rich., Fred. & Potomac	Rich., Fred. & Potomac	15
Rich. & York River	Southern	20
Rich. & Petersburg	Atlantic Coast Line	22
Clover Hill Branch	Tidewater & Western	18
Richmond & Danville	Southern	140
South Side	Norfolk & Western	62
Army Line and Branches		18
Norfolk & Petersburg	Norfolk & Western	44
Seaboard & Roanoke	Seaboard Air Line	17
Winchester & Potomac	Baltimore & Ohio	28
West. Md.	West. Md.	36
Hanover Br. & Gettysburg	West. Md.	30
		611

Railroads in Tennessee, Georgia, Mississippi, Kentucky and Arkansas

	Now part of—	Miles Used.
Nashville & Chattanooga	Nash., Chattanooga & St. L.	151
Nashville, Decatur & Stevenson	Louisville & Nashville	200
Nashville & Northwestern	Nash., Chattanooga & St. L.	78
Nashville & Clarksville	Louisville & Nashville	62
Shelbyville Br.	Nash., Chattanooga & St. L.	9
McMinnville & Manchester	Nash., Chattanooga & St. L.	35
Mt. Pleasant Br.	Louisville & Nashville	12
Chattanooga & Knoxville	Southern	112
Cleveland & Dalton	Southern	27
Knoxville & Bristol	Southern	110
Rogersville & Jefferson	Southern	12
Chattanooga & Atlanta	Western & Atlantic	136
Rome Br.	Western & Atlantic	17
Atlanta & Macon	Central of Georgia	11
Memphis & Charleston	Southern	75
Mississippi Cent.	Illinois Central	68
Mobile & Ohio	Mobile & Ohio	38
Memphis & Little Rock	Chicago, Rock Island & Pacific	49
Louisville City	Louisville & Nashville	2
		1,201

Railroads in North Carolina

	Now part of—	Miles Used.
Atlantic & N. C.	Norfolk Southern	95
Wil. & Weldon	Atlantic Coast Line	85
North Carolina	Southern	88
Raleigh & Gaston	Seaboard Air Line	25
		293

Railroads Taken Up to Secure Rails

Virginia

Seaboard & Roanoke	Seaboard Air Line	14
Norfolk & Petersburg	Norfolk & Western	14
Manassas Gap	Southern	35
Rich. & York River	Southern	13
Mississippi		
Winchester & Fayetteville	Nash., Chattanooga & St. L.	41
McMinnville & Manchester	Nash., Chattanooga & St. L.	26
Mt. Pleasant Br.	Louisville & Nashville	12
		156

McCallum largely confined his activities to the railways that were taken over by the government for the operations around Richmond, until about one year later when he was put in absolute charge of the more extensive railway lines in Tennessee and Georgia, or the "Military Division of the Mississippi."

General Haupt and His Authority

On the many little lines constituting this mileage most of the important problems of railway transportation in or near a zone of war first found solution. The most important of these was that of authority. It took many months and much friction to settle the question. But there could be only one result—railways must be operated by railwaymen. The railway man who proved the soundness of that conclusion was, however, not McCallum so much as Herman Haupt, called to military service from work on the Hoosac Tunnel —a project then just at its inception. Haupt, a West Point graduate, carried to his task both railway and military

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Brig. Gen. D. S. McCallum

experience. In a number of cases he was able to advise the generals with whom he worked as to military operations. Even Lincoln often called upon him for information and advice.

Haupt came first to the service as chief of construction and transportation in the Department of Rappahannock. He worked well with McDowell, the department's commander, but quite the opposite with General Pope, McDowell's successor. Pope entirely disregarded Haupt's position, would not advise him as to needed transportation, and finally so disgusted him that he went home. "Come back immediately. Cannot get on without you. Not a wheel moving" was the message Haupt received 10 days later from the Secretary of War. "I then turned my attention," he says of his return to grace, "to reorganize the transportation which had again been thrown into confusion from the usual causes—military interference, neglect to unload and return cars, too many heads, and as a consequence conflicting orders." Haupt was soon put in charge of all the railways of the Army of Virginia, but Pope was not the only officer he had to convince of the necessity of letting railwaymen operate the railways.

"Take Your Damned Railroad"

A general, by name Sturgis, one day called upon Haupt for special trains to carry 10,000 men and their equipment to a battlefield a mere 18 miles away. Haupt refused the cars on the ground that he needed the equipment elsewhere for much more important work. He further expressed the opinion that 18 miles could easily be covered on foot and

far more safely, for men in the cars would be almost defenceless against attack, while in marching order they could be ready on the instant. Sturgis, nevertheless, threatened to put Haupt under arrest and in the meantime held up operation entirely on the little single track line. Only did he recede when Haupt presented a telegram from the commander-in-chief which said, "No military officer has any authority to interfere with your control over railroad. Show this to General Sturgis and if he attempts to interfere, I will arrest him." "He does, does he?" said Sturgis, "Well, then, take your damned railroad!"

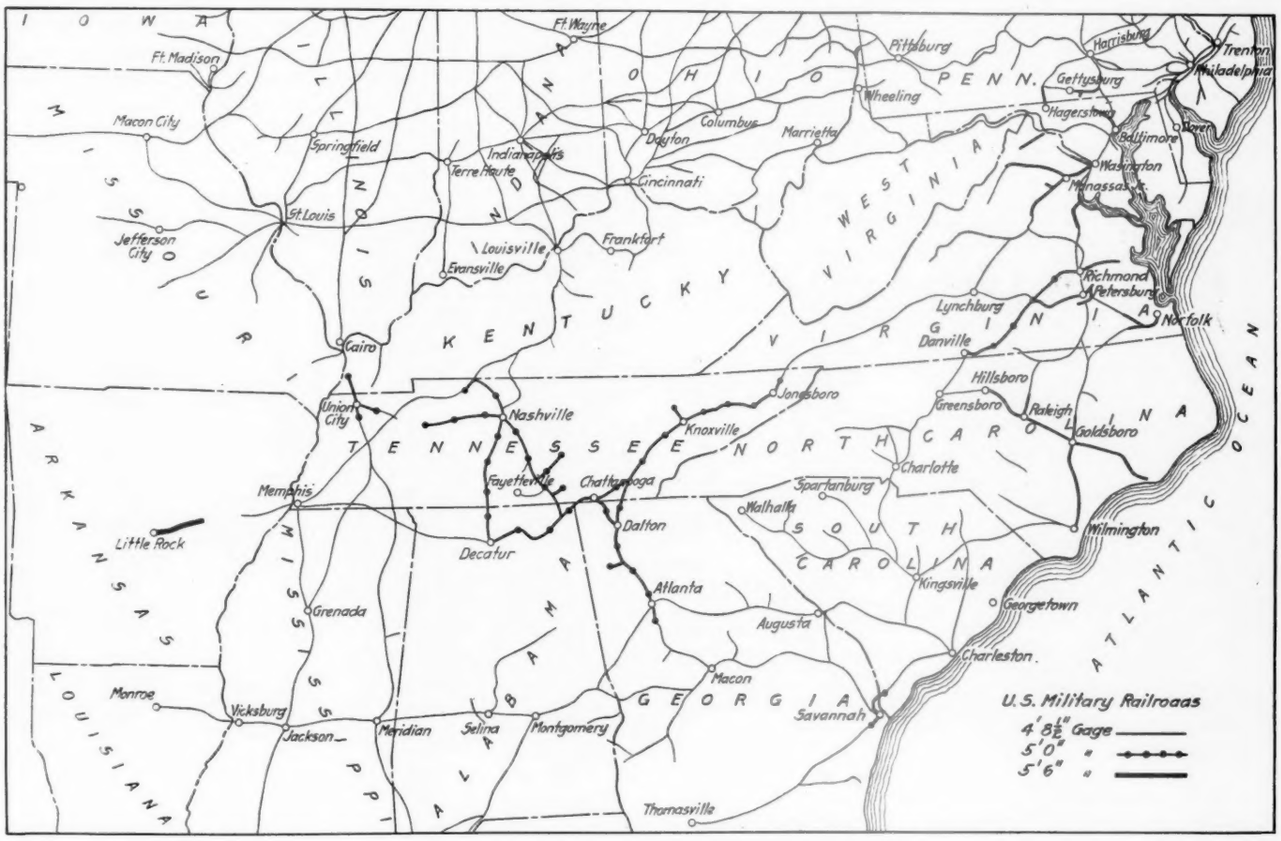
Difficulties of Military Railroad Operation

Haupt was so convinced of the necessity of letting the railways be operated by those who knew them best, that he did not superimpose his own authority on other railway men. "I was clearly of the opinion," he says, "that it was expedient in general to operate the railroads used for military purposes by and through the regular officers and employees of such roads using military authority only when necessary to render assistance to them in procuring rolling stock, or securing regularity of train movements."

Haupt reported to General Halleck that the many embarrassments, irregularities and blockades on the Military Railroads were due to three causes: (1) Sending supplies to the advanced terminus before they are required. (2) Lack of promptness in unloading and returning cars. *"Cars are sometimes kept for weeks as storehouses."* (3) Detaining trains beyond schedule time.

He did not tell Halleck in this letter, but it is in his Reminiscences, about the single track line that was blockaded three hours by a train waiting for an officer's wife to look for rooms, or about the paymaster who took his station in a car on the single track main line and had to be driven off by troops. But the funniest thing of all is the remark he makes to the effect that more trouble was often given by the Union soldiers themselves than by the enemy. Soldiers in camp were sometimes prone to tear up sidings, break switch stands, use for campfires the wood provided for the engine and to wash clothes and persons in the springs and streams which supplied the water stations, with the result that many engines were stopped on the road by foaming due to soapy water.

Haupt's task must indeed have been a hard one, even with the assistance of the authorities over him. Halleck telegraphed on one occasion, "No military officer will give any orders to your subordinates except through you, nor will any of them attempt to interfere with the running of trains."



The Military and Other Railroads in the Civil War

The Assistant Secretary of War once advised, "Be patient as possible with the generals. Some of them will trouble you more than they will the enemy."

The Solution of the Problem

But the problem had to be solved, so solved it was, and one of the orders that did the most to solve it follows:

WAR DEPARTMENT,

Adjutant-General's Office,

WASHINGTON, November 10, 1862.

SPECIAL ORDER

Commanding officers of troops along the United States Military Railroads will give all facilities to the officers of the road and the Quartermasters for loading and unloading cars so as to prevent any delay. On arrival at Depots, whether in the day or night, the cars will be instantly unloaded, and working parties will always be in readiness for that duty, and sufficient to unload the whole train at once.

Commanding officers will be charged with guarding the track, sidings, wood, water tanks, etc., within their several commands, and will be held responsible for the result.

Any military officer who shall neglect his duty in this respect will be reported by the Quartermasters and officers of the railroad, and his name will be stricken from the rolls of the Army.

Depots will be established at suitable points under the direction of the

Commanding General of the Army of the Potomac, and properly guarded. No officer, whatever may be his rank, will interfere with the running of the cars, as directed by the superintendent of the road. Any one who so interferes will be dismissed from the service for disobedience of orders.

By order of the Secretary of War.

J. C. KELTON.

McCallum says of this order that it was issued "in consequence of several attempts having been made to operate railroads by army or departmental commanders, which had, without exception, proved signal failures disorganizing in tendency and destructive of all discipline. Having had a somewhat extensive railroad experience both before and since the rebellion, I consider this order of the Secretary of War to have been the very foundation of success; without it the whole railroad system, which had proved an important element in conducting military movements, would have been not only a costly but ludicrous failure. The fact should be understood that the management of railroads is just as much a distinct profession as is that of the art of war, and should be so regarded."

Construction and Destruction of Railway Lines

"It was the American Civil War that was to elevate railway destruction and restoration into a science and to see the establishment in the interest of such science of an organization which was to become a model for European countries and influence the whole subsequent course of modern warfare," says Edwin A. Pratt in his authoritative book on the "Rise of Rail Power in War and Conquest."

The Union lines were ever very susceptible to Confederate attack. Armies were not held in place by trenches and barbed wire entanglements in the Civil War, and no aeroplanes were overhead to spot a raiding force that might be pushing its way through wide stretches of field and forest towards or around an army's lines. Nor was it always possible to guard a line with sufficient men; armies did not fight with millions then. The activities of the Federal forces in the earlier months of the war were confined to restoration of railways; it was not until Sherman's march to the sea that they also found it necessary to perfect an organization for the destruction of railway property.

In 1861, at the very outset, the Confederates started things by raiding the Baltimore & Ohio at Martinsburg, W. Va. They destroyed a large number of locomotives and took 20 away over a dirt road 40 miles across country to Winchester, whence they were taken to Richmond and put in service. They shortly afterward wiped out completely 100 miles of the North Missouri Railroad. In April, 1862, they completely devastated the Fredericksburg Railway between Richmond and Washington with a view to preventing the joining of the armies of the Rappahannock and the Potomac. Haupt was called upon to restore the line, which he did with commendable thoroughness and speed. With a force consisting only of soldiers detailed from regular service he rebuilt the Akakeek bridge, a single span, 120 ft. long and 30 ft. high, in 15 working hours, and the Potomac Creek bridge 414 ft. long, 82 ft. above the water in nine days. His force relaid three miles of track in three days, and to do it his inexperienced soldiers had to cut 3,000 ties. All this work was done in wet weather with an insufficient supply of tools and sometimes of food.

The Potomac bridge was later destroyed again, and in May, 1864, a more experienced force rebuilt a better bridge in 40 working hours. Haupt gradually perfected his organization, introduced standard parts, and had so developed the bridge building that by merely hoisting the pieces into place without fitting, a bridge could be built "about as fast as a dog could trot." At another time the Massaponix bridge six miles from Fredericksburg was rebuilt in half a day. Five bridges over Goose Creek were rebuilt in May, 1862, in a day and half. Nineteen bridges on the Northern Central were destroyed while the battle of Gettysburg was raging and renewed by noon of the day following the Confederate retreat. In the course of the war, one bridge over Bull Run was rebuilt no less than seven times, following Confederate raids.

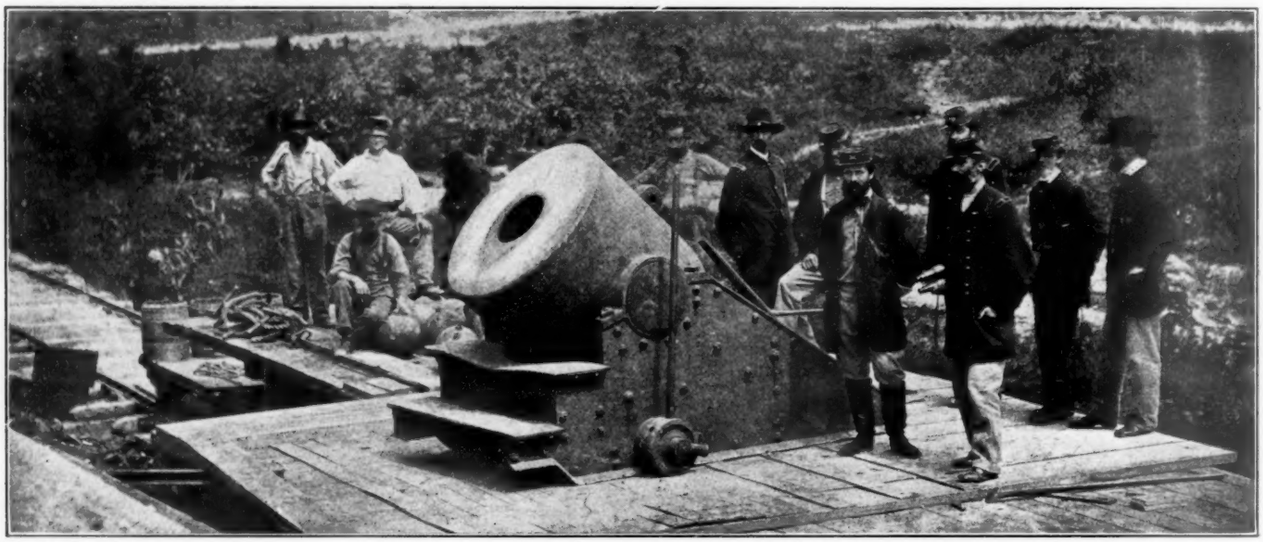


Photo from Brown Bros.

The Dictator, the First Fortress Train, Before Petersburg

Military Division of the Mississippi

When McCallum was made general manager of the Military Division of the Mississippi in February, 1864, he found the single track Nashville & Chattanooga supplying an army at Chattanooga from the depots at Nashville 151 miles away. The line was poorly maintained and worse equipped. "The track," to use his own words, "was laid originally on an unballasted mud roadbed in a very imperfect manner, with a light U-rail on wooden stringers, which were badly decayed and caused almost daily accidents by spreading apart and letting the engines and cars drop between them." The equipment consisted of 50 locomotives, of which 11 were disabled, and 537 cars; of which only 400 were in running order. McCallum promptly perfected a more efficient organization, and secured additional equipment from the railway supply companies.

The organization he divided into two parts, a transportation department and a construction department. The former he placed in charge of A. Anderson, as general superintendent of transportation and maintenance, in charge of conducting transportation, and of maintaining roads and structures, cars and locomotives. The lines were divided into principal lines or divisions, each in charge of a superintendent of transportation. Reporting to the latter were one or more masters of transportation who moved over the railroad to supervise its operation. Engine despatchers saw to it that the locomotives were properly repaired and cleaned and assigned the crews. On each division the maintenance of road and structures was in charge of a superintendent of repairs, the cars in charge of a master of car repairs and the locomotives of a master machinist. The maximum force in the transportation department at any one time was 12,000 men.

W. W. Wright was chosen chief engineer of construction. His department had a maximum strength of 5,000 men and was divided into six divisions, each one of which constituted a complete and independent unit. Each division was in charge of a division engineer, and was made up of subdivisions, each in command of a supervisor. A complete division consisted of 777 men divided about as follows: General, 6; bridge and carpenter work, 356; track, 356; water stations, 15; masonry, 13; ox-brigade, 20; train crew 11.

Nashville & Chattanooga

With this organization McCallum did remarkable work. His task was to supply the Union armies working towards Atlanta by means of his railway lines from Nashville. The scheme he worked out was to make Nashville and Chattanooga important terminals connected by a well maintained and equipped main line, and as the Union forces advanced he extended his organization until the railway ultimately reached Atlanta, 472 miles from Nashville.

McCallum's forces rebuilt about 115 miles of track, and put in 19 miles of sidings. These sidings averaged about 8 miles apart, and each could hold from 5 to 8 long trains. At each was a telegraph station to facilitate railway operation. At Nashville and Chattanooga, the two important terminals, storehouses and repair shops were erected, the shops at Nashville being so extensive that they could accommodate 100 locomotives and 1,000 cars at one time.

The Union forces had considerable difficulty in getting rails. McCallum made large purchases from the Northern rail mills; he even built a rail mill near Chattanooga, but on several occasions had to tear up nearby lines not urgently needed in order to use their rails.

35-Mile Break Repaired in 7½ Days

The repair organization was always ready for action. Sections of it were distributed over the line at strategic points, and methods were so perfected that a break in the line at any point could be repaired from either end. The Union forces at all times found it difficult to guard the line adequately and Confederate raiders frequently interrupted communications. So effective was McCallum's organization, however, that in very few cases was the line blocked more than a few hours. The Western & Atlantic, that part of the line from Chattanooga to Atlanta, was a special object of attack. On one occasion the Union forces were called up to rebuild the Chattahoochee bridge near Atlanta, 780 ft. long and 92 ft. high, in four and one-half days. On another occasion the Confederate forces under Hood attempted to cut off Sherman's communications by cutting the railway in his rear. The Confederates destroyed 250 ft. of bridges and made two extensive cuts in the line, one of 10 and another of 25 miles, besides destroying stores and railway supplies. McCallum's forces had the breaks repaired in seven and one-half days. Repair forces were immediately put on the job from either end. The 10-mile break was repaired even before Hood had left the road, and the force then passed on to the larger break. New ties had to be cut near the line of the road and rails secured from railroads south of Atlanta, or from Nashville, 200 miles to the north.

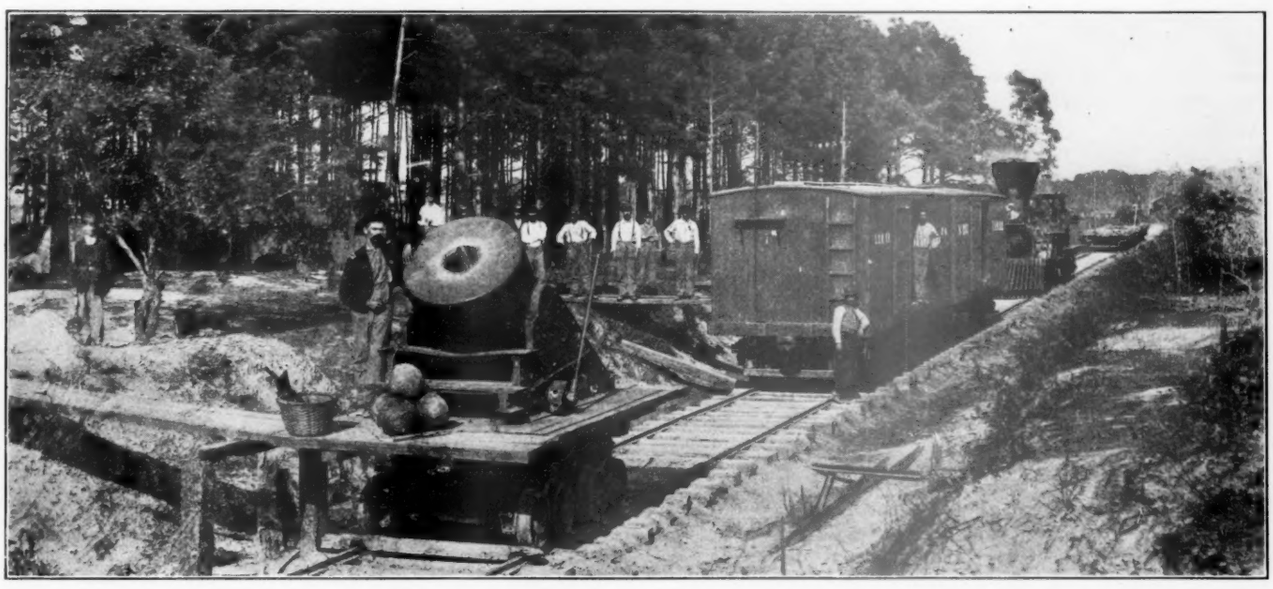


Photo from Brown Bros.

Mortar Mounted on a Platform Car

Destruction of Railway Property

After Sherman had captured Atlanta, and started on his march through Georgia, the work of the Union railwaymen took on a new aspect, the work of destruction rather than of construction. The railway lines to Sherman's rear were destroyed by the Union troops beyond all hope of repair, for the railwaymen worked most effectively, and the Confederates lacked rails, cars and locomotives as well as facilities for making them. The Union ingenuity developed all kinds of methods of destruction. Bridges they burned, or else blew to pieces by well-placed torpedoes. Freight cars were

burned. Locomotives were destroyed by firing them without water in the boilers, or better still, by putting a cannon ball through the boiler. Rails were the hardest to put out of commission. The Confederates had adopted a practice of tearing up ties and iron, building fires of the ties and putting the rails on top. When the rails were heated they were tied in bow knots around the trees. The Union forces found this method too slow and besides it quickly developed that the rails could easily be bent back into shape. They, therefore, went one step further, developed special hooks and using fence rails as levers, bent and twisted the rails cold into such a state that they could not be repaired except by rerolling them.

An Enviable Record

The Military Railroads of the United States operated 2,105 miles of line, 611 in Virginia, 293 in North Carolina and 1,201 in the military division of the Mississippi. On these lines they used 419 locomotives and 6,330 cars. The forces in service at their maximum, that is near the close of the war, totaled over 22,000 men, including 17,035 in the west, 4,542 in Virginia and the forces sent to North Carolina. These forces left a record of accomplishment behind them, for they built or rebuilt no less than 642 miles of main track and 137,418 lineal feet or over 26 miles of bridges.

And the task was never an easy one either for officers or men. It was always difficult to secure sufficient forces, for with the rapid expansion of railways prior to the Civil War there were none too many railwaymen, and enlistments of railwaymen with the regular forces were so great that skilled operatives could ill be spared. The record that the railwaymen made is an enviable one. McCallum recites that the train crews in particular worked hard and suffered as great hardship and peril as any soldiers engaged in active service. It was by no means rare for men to be out with their trains with almost no sleep for from 5 to 10 days, and sometimes with little food, while occupied in arduous work.

Let him tell the story: "Many incidents during the war, but more especially during the Atlanta campaign exhibited a fortitude, endurance and self-denial on the part of these men, not exceeded in any branch of the service. All were thoroughly imbued with the fact that upon the success of railroad operations in forwarding supplies to the front, depended in great part, the success of our armies, that although defeat might be the result, even if supplies were abundantly furnished, it was evident there could be no advance without; and I hazard nothing in saying that should failure have taken place either in keeping the lines in repair, or in operating them, General Sherman's campaign, instead of proving as it did, a great success, would have resulted in disaster and defeat, and the greater the army to supply the more precarious its position."

The Telegraph

It would not be fair in speaking of Military Railroads to omit mention of the telegraph. As a rule, so requisite was the use of the wires for the armies that it was usually judged more expedient to regulate train service if possible by schedules. But the telegraphers had their work to do, and one of the most interesting features of the war is the story of how telegraphers in advanced and dangerous positions kept their superiors informed by wire of what was going on ahead. Usually the telegraph was used for railway operation only in case of derangement of schedules, and if it could not be used runners were sent to meet trains and relieved when fatigued. The system of operating without wires was worked out so successfully that during the battle of Gettysburg 30 trains were operated daily over a road that had a normal traffic of only three or four a day.

Photo from Brown Bros.

The Confederates Left This Behind Them When They Retreated from Manassas Junction in March, 1862

General Sherman has told us something about the efficient results that were obtained in operation on the railways in the west. "Our trains from Nashville to Chattanooga," he said, "were operated under military rules and ran about 10 miles an hour in gangs of four trains of 10 cars each. Four such groups of trains daily made 160 cars of 10 tons each, which exceeded the absolute necessity of the army and allowed for incidents that were common and inevitable."

The Military Railroads also gained some laurels for handling troops. The record does not sound big to-day, but it was quite an advance in the art of troop transportation when 16,000 men were brought from Culpeper Court House, Va., to Washington by rail, there transferred to the Baltimore & Ohio and carried via Wheeling, Columbus, Indianapolis, Louisville and Nashville to Stevenson and Bridgeport, Ala., in eight days' time.

The soldiers did not ride in tourist sleepers in those days. In fact, men in the field, particularly anywhere in the west, felt themselves lucky if they could ride at all, whether inside or on the roofs of box cars. If by any chance they could ride in cars with lateral pine seats and four small

windows in the side of the car, they considered their good fortune almost beyond belief. After the war was over regiment after regiment was carried home in ordinary box cars to points as far north as New England.

The Other Railroads

The Military Railroads of the United States played perhaps the most spectacular part in the Civil War, but not the only part. Railroads like the Baltimore & Ohio, the Philadelphia, Wilmington & Baltimore, the Northern Central, the Cumberland Valley, and the Illinois Central, as well as others near the zone of war, wrote some feats of accomplishment in their records that will never be forgotten.

"The efficiency of the management of the Baltimore & Ohio," says General Haupt, "their readiness to give government supplies the preference over all other trains and the capacity of the road which is greater than all ordinary or even extraordinary demands that may be made upon it, left nothing more to be desired *except the prompt return of cars from the advanced terminus.*"

Speedy Runs

We have been reading lately of some rather speedy runs with government and other supplies over the railways of this country. Whether they beat some of the records in

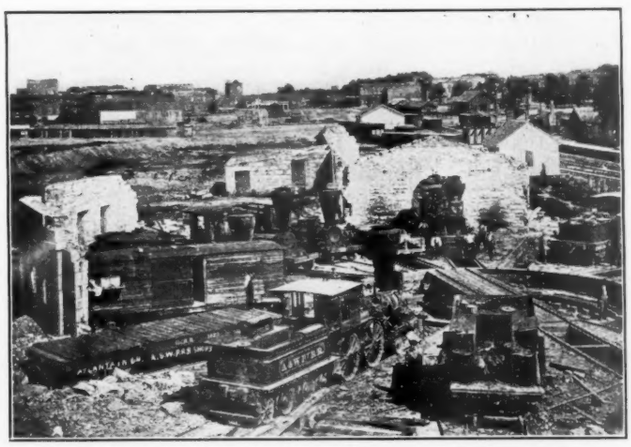


Photo from Brown Bros.

Remains of a Round House in Atlanta, 1864

the Civil War we have not had time to ascertain, but it is a safe guess that they did not beat the experiences. On September 18, 1862, the Northern Central handled a train moving toward Hagerstown after the battle of Antietam 84 miles in 2 hr. 53 min. And if the speed was not remarkable enough the reader should remember that the cars had hand brakes only, that the journal boxes smoked most of the distance, and that the rail was out of surface as much as out of line. That same train continued on the Cumberland Valley after a delay of 24 minutes at Bridgeport waiting for an additional car of ammunition, and arrived at Hagerstown, 74 miles away, in 1 hr. 58 min., including a stop of 10 minutes at Chambersburg for cooling off the journals—a speed of 45 miles an hour. The train thus traveled from Baltimore to Hagerstown, 158 miles, over three roads in 4 hr. 31 min., nearly 37 miles an hour. Small wonder that the journals on four cars were ablaze when the train reached Hagerstown.

Protection Against Home Guards

Guarding railway property must have been a ticklish job for railways not having regular forces to assist them. The Philadelphia, Wilmington & Baltimore had a risky experience along this line with home guards. There were three such organizations along the lines, but a bit of discreet investigations disclosed that two were of very strong Southern sympathies, with wicked designs implanted in their souls. President Felton was as keen as any of them, however, and that is why he organized and armed a force of about 200 men, which he distributed along the line between Susquehanna and Baltimore, ostensibly to whitewash

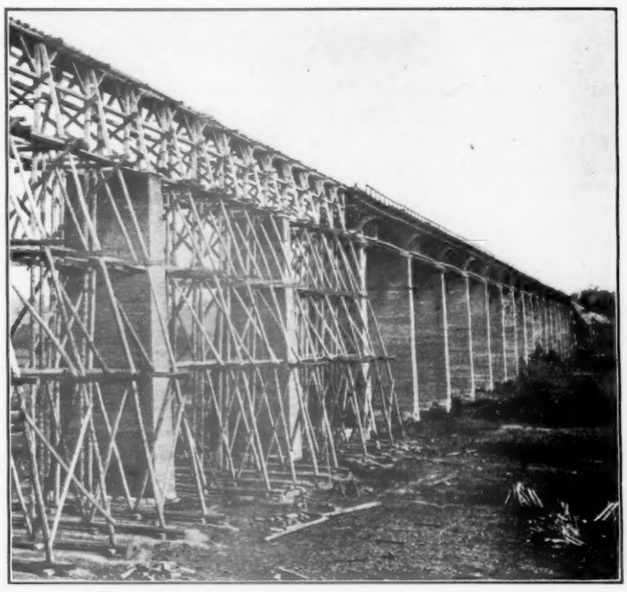


Photo from Brown Bros.

High Bridge Crossing the Appomattox, near Farmville, Va.

bridges. This they did with a vengeance, going over some of them with six or seven coats mixed with salt and alum. The excellent fireproofing soon after came in very handy, but it did not prevent Southern sympathizers from Baltimore from cutting off 40 miles of line south of Susquehanna.

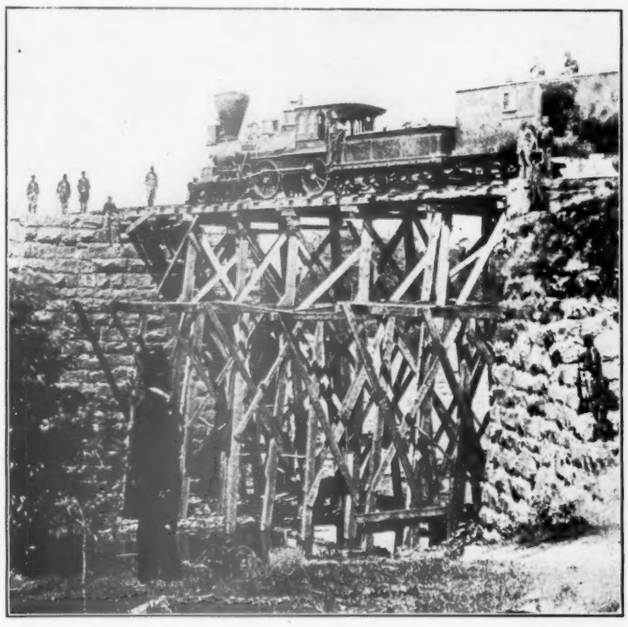


Photo from Brown Bros.

Bridge on the Orange & Alexandria Repaired by Military Railroad Engineers

Nor did the cutting off of 40 miles of line in turn interrupt communications with Washington. Troops were detoured from Perryville by steamer to Annapolis, and thence by the Annapolis branch and the Baltimore & Ohio to the capital.

Lack of Skilled Railway Men

The railways outside the zone of war found it even more difficult to maintain their organization than the officers of the Military Railroads. The railway men of our Civil War were only too eager to do their part to preserve their nation, and so great were their enlistments that they simply could not be replaced. The border roads were especially hard hit, because they had to handle so much war traffic with insufficient forces. On occasions operation of parts of what is now the Pennsylvania System actually had to stop because of lack of crews. And even among the crews they did have there were too few skilled men; and there were too few skilled officers. It was not easy either to secure new cars and locomotives; skilled men were at a premium everywhere. These difficulties naturally made the railroads desire greatly the exemption of all their employees from the draft. Locomotive runners and telegraph operators only were afforded exemption. Secretary of War Stanton refused to increase the list of exemptions, but he advised Thomas A. Scott that if certain experts were drafted they would be discharged.

The Railroads in the Confederacy

The mileage of railroads in the Confederate States in 1861 was slightly over 6,000 miles. These lines the Confederates found it absolutely impossible to maintain. They were not as a rule well built in the first place, and they simply went from bad to worse. To secure new cars and locomotives or repair parts was beyond all possibility, for prior to the war practically freight cars only did not have to be obtained from the North, and even for cars only wood could be found in the South. And the deterioration had grievous results. While Sherman's army was rolling in plenty on its march through Georgia, Lee's men at Richmond were nearly starved. In January, 1864, corn selling at $1 to $2 a bushel in southwestern Georgia cost $12 or $15 in Virginia, and lack of efficient transportation was almost the only cause. Perhaps the Confederate Secretary of War could not be blamed for complaining about the "dilatory and irregular transportation on the railroads."

THE SPANISH-AMERICAN WAR

The curve of accomplishment of the American railways in war took a decided downward trend in 1898, and it is perhaps wise to say as little as possible about the fiasco of the summer of that year. But it was not the railways' fault; it was due to nothing else than a lack of co-operation on the part of the railways and the government, as well as to an absolute disregard of the important principle taught in our Civil War, namely, that the railwaymen should operate the railways.

The trouble, as nearly every one well knows, lay in the fact that concentration was at Tampa, while the point of embarkation was at Port Tampa, nine miles beyond and on a little terminal railroad. Practically all shipments either of men or supplies were made to Tampa, and then reshipped to the port of embarkation; the attempt was made to handle a heavy transfer of men and their equipment, where each time a few cars were unloaded they had to be pulled back over a long distance in the face of an opposite incoming traffic movement. Naturally, most of the difficulties would have been obviated if the men and supplies had been held back, and then shipped direct to Port Tampa for transfer to the ships, and if there had been sufficient trackage to the piers.

The story goes that one shipment of four cars of ammunition left by express from the north the same day as a shipment by freight. The freight shipment took two weeks, but the express shipment was still being expected when the freight arrived. And a railroad man has to laugh when he hears about the order not to send more than 500 troops a day through Jersey City to avoid tying up that terminal. Or about the telegram, "we are starting a special train load of supplies from Philadelphia to Tampa, with a representative of the Quartermaster's Department in charge of the train. Be on the lookout for them." Three weeks it took to find the train, and then it was at Turkey Creek, 18 miles from Tampa. Colonel Bellinger of the Q. M. C., stated, "So far as I am aware, the representative of the Quartermaster's Department who was in charge of the train has not yet arrived." And so the story goes; it's not an enviable one. But the railwaymen were not the only ones. Too many cases were on record in this war where officers of the State Militia were absolutely heedless of the necessity of moving trains and of operating the railroad.

THE MEXICAN BORDER MOVEMENTS

The movement of troops to the Mexican border is so recent that but passing mention needs to be made of it. Let us quote from the report of the Quartermaster General of the United States Army given in the *Railway Age Gazette* of December 29, 1916, page 1207. From the beginning of the movement up to July 31, 111,919 militia troops were moved to the international boundary. "Considering the great distances traveled by the militia from the various camps to the Mexican border, the fact that there was but a single accident, and that of a minor character, the celerity with which the trains were moved and the entire absence of congestion and delay, it is believed that there has been no case in history where troops have been as well and as safely transported or as well cared for while en route as in the recent mobilization."

OPERATING EFFICIENCY DURING THE WAR

At the request of the Executive Committee of the Special Committee on National Defense, for the purpose of ascertaining what results are being attained by the American railroads to increase their operating efficiency during the continuance of the war, the Bureau of Railway Economics is compiling monthly reports of freight operation. For this purpose blanks have been distributed to the railroads with a letter signed by Fairfax Harrison, chairman of the Executive Committee, requesting them to fill out and return each month, beginning with the month of April, reports of freight operations designed to show the ton mileage handled by each road, freight locomotives and freight car mileage and the percentage of freight locomotives and freight cars in shop or awaiting shop.

The schedule enclosed, which the roads were asked to fill in promptly and return to the Bureau of Railway Economics at Washington, is designed to show these facts both for the current months of the present year and for the corresponding months of 1916, together with the amount of increase or decrease. The schedule calls for the information in the following items: Freight train-miles, loaded freight car-miles, empty freight car-miles, total freight car-miles, loaded and empty, freight locomotive-miles, revenue ton-miles, non-revenue ton-miles, average number of freight locomotives in service, average number of freight locomotives in shop or awaiting shop, average number of freight cars in service, average number of freight cars in shop or awaiting shop (a. home, b. foreign), tons per train, tons per loaded car, average miles per locomotive per day, average miles per car per day, per cent of empty car-miles, per cent of freight locomotives in shop or awaiting shop, per cent of freight cars in shop or awaiting shop, and average miles operated-single track.

Enlistments on the Santa Fe.—The Santa Fe Lines announce that 618 employees from all branches of railway service have enlisted in the army or navy. Of this number 160 are in the Santa Fe company of the Third Reserve Engineers, now in camp at Chicago.

Electric Gantry Crane and Lifting Magnet Handling Scrap

Electricity as an Aid to Railroad Operation

Many Ways by Which This Agency May Be Made to Contribute to Increased Efficiency and Capacity

SOME time ago, during a presentation speech, Frank J. Sprague said that he considered the recipient of the honor a good electrical engineer because he never did anything electrically that he could do better mechanically. Steam railroad men, because of their continued association with steam and other mechanical devices, too often do things mechanically that could better be done electrically. It is the purpose of this article to suggest certain applications of electrical energy which will increase the all-around efficiency of the railroads and thereby speed up the transportation of freight and other commodities.

There is no question but that the railroads are the backbone and spinal cord of the country during this national crisis and for that reason they will work under a tremendous overload, not only during the war but perhaps for years afterwards. For this reason it is important that every method and device at their command be availed of to keep them in the best possible working condition.

Electricity and the modern machinery which it operates and controls will be found a most effective ally and help. Many things touched upon in this article are not new; they are simply mentioned as reminders; some, however, are recent developments worthy of careful attention as result getters.

Electricity on Steam Roads

INDIVIDUAL motor drive should be used for shop tools, cranes, hoists, turntables, pumps, etc.

Shops, terminals and yards should be adequately illuminated.

The electric arc should be used for welding, building up worn parts and boiler work.

Freight terminals may be speeded up by the use of electric conveyors, winches, trucks, cranes, and other special electrically operated freight handling machinery.

Electric traction will increase the capacity of a heavy mountain division approximately 50 per cent.

The principal uses of electrical energy on a steam railroad system are: (1) Motor drive for shop tools, cranes, hoists, turntables, pumps, etc.; (2) electric welding; (3) electrical lighting of shops, yards, bridges, cars, etc.; (4) modern electric freight handling machinery for use in large freight terminals; (5) the electrification of portions of the main line containing heavy mountain grades or which are congested because of dense traffic, tunnels, etc.

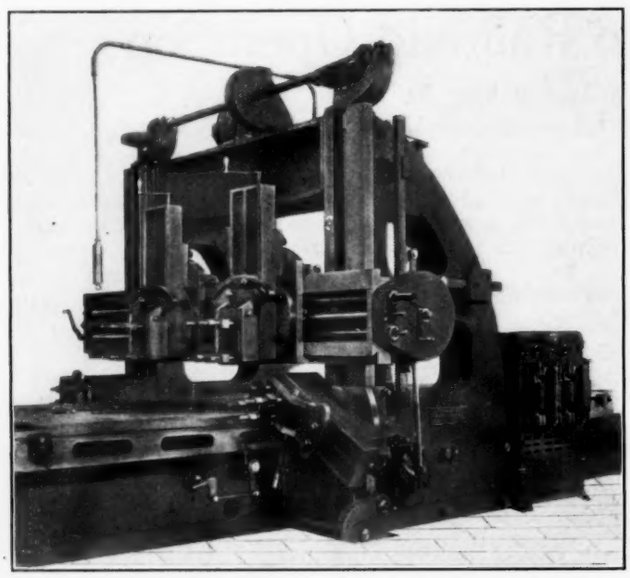
Motor Drive for Shop Tools

The electric motor is now generally recognized as the most satisfactory and economical drive for railroad shop machinery. Briefly, the general advantages of this form of drive are: The operating cost is considerably decreased by eliminating belt and line shafts with their high friction losses and maintenance expense. Individual motor driven machines are independent of each other or of their source of power and, therefore, can be so located in the shops that the floor space and the machine tool, itself, can be used to the best advantage. The speeds of metal working machines can instantly be adjusted to the most economical cutting rate. The absence of belts and line shafting results in better light and ventilation and, in general, improves the working conditions in the

shop which means more accurate work and increased output.

Perhaps the greatest advantage of the motor drive from the railroad's point of view is that of increased production made possible by heavier cuts. The cuts on belt driven machines are limited by the belt slip; this is especially true of planers, slotters, wheel lathes, etc., but with motor driven tools the cuts may be increased to any desired amount particularly when direct connected motors are used. In some railroad shops small steam engines are scattered through the shop for the purpose of driving sections of line shafting, the steam being furnished from the central power station through long lengths of steam pipes. By changing over to electric drive the losses in the steam pipe, which often amount to 50 per cent, are at once eliminated. As the line losses in an electric feeder should not be more than five per cent there would generally be a net saving of 45 per cent. This advantage, where steam engines are so used, is over and above those previously mentioned.

While any form of electric drive is desirable, experience has indicated that alternating current motors are particularly adapted to special classes of tools and machines while other classes of machines will give a considerably greater output if driven by direct current motors. Briefly, all machines which are essentially constant speed, and these perhaps are



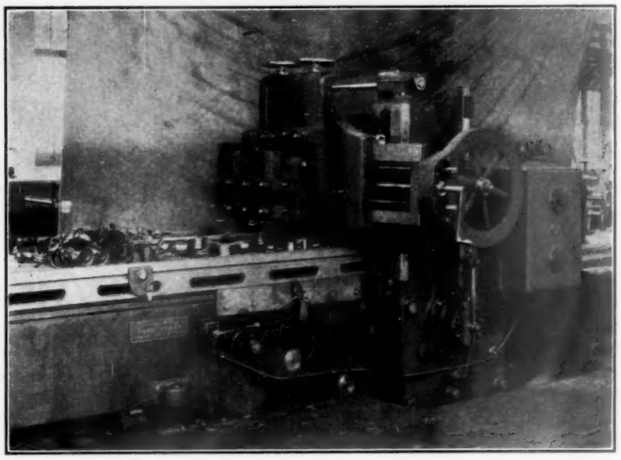
Planer Equipped with a Reversing Direct Connected Motor. It Will Turn Out 50 Per Cent More Work with 40 Per Cent Less Power Than a Similar Belt Driven Tool

in the majority in railroad shops, should be driven by the simple induction motor; on the other hand all machines requiring speed adjustment, either inherently or to obtain maximum production, should be driven by direct-current motors. As a general rule it may be said that in machine shops now equipped throughout with alternating current induction motors, it would be a paying investment to install a motor-generator set for the purpose of supplying direct current to those machines which are greatly handicapped if not driven by direct-current motors. In the average railroad shop the yearly saving based on the increased output would more than pay for the cost of the motor-generator set and the additional wiring.

Reversing Motors for Planers

One of the most important developments in machine tool drives during the past few years has been the application of direct connected, reversing, direct-current motors to such machine tools as planers, slotters, etc. The two principal advantages are the large increase in production and the saving in power consumption, of which the former is by far the most important. One of the large switch and frog companies has found that a certain planer, driven by a direct current reversing motor, gave seven times the output of a similar belt driven machine. The average results of a long series of tests made on belt and reversing direct connected electric motor driven planers were that by the use of such a motor the power consumption was reduced 37 per cent and the amount of metal removed per unit of time was increased 50 per cent.

As an indication of the increased production which results from the use of the direct connected motor to planers it was



Heavy Pattern Frog and Switch Planer Driven by a 50 H. P. Direct-Connected Reversing Motor. Note the Extremely Heavy Cuts

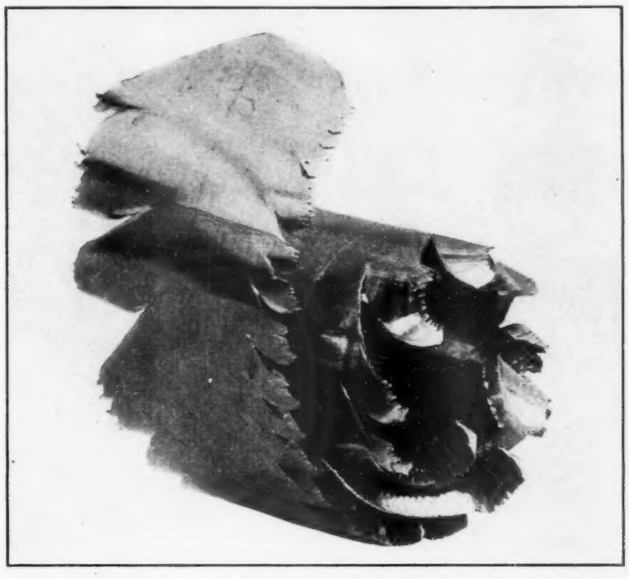
found when testing one machine (72 in. by 22 ft.) that the time lost by the belt drive as compared with the direct connected reversing motor drive on the whole cycle (depth of cut and speed the same in both cases) was 62 per cent. This means that if the two machines had started to cut at the same time, the motor driven machine would make one cut, one return, and one-third of the second cut while the belt-driven machine completed only one cutting stroke. Even with this increase in production the power consumption was considerably less. This great increase is due to the fact that the power available at the cutting tool of the belt driven machine is limited by the belt slip, while the power available on the motor driven machine is dependent only on the size of the motor and the strength of the machine tool. It is entirely feasible to connect reversing direct current motors to old planers, as has been successfully demonstrated in a large number of cases.

Motor Control

For adjustable speed, direct-current work, two types of control are used. The one in most general use is of the drum type but this is now being superseded, in many cases, by the so-called automatic magnetic control. Magnetic starters are also used for constant speed motors of the induction type. The advantages of the magnetic control lie in the fact that automatic acceleration can be obtained at the highest rate consistent with the load of the driven machine without special attention or effort on the part of the operator, who is thus free to give all his time to the operation of the machine. Production is thus materially increased.

The application of the individual motor drive with automatic control to car wheel and driving wheel lathes has been found materially to increase the production and to effect a considerable saving in the power consumption. By use of

the push button switch furnished with the automatic control the lathe may be started, stopped, slowed down and reversed by the operator without leaving the machine. The machine is started by the "start" button and when the "stop" button is pushed the motor is brought to rest immediately by dynamic braking; that is, by changing the motor connection so it operates as a generator. In case hard spots on the wheels are encountered the "slow" button is pushed which slows the motor down to a speed at which the hard spot can be cut without injuring the tool. When the hard spot has been passed by the tool the lathe is brought back to normal



Chip 2⅛ in. by ⅛ in. Feed, Weight 2 lb. 6 oz. 8.4 cu. in. Made by Heavy Duty Planer Machining Special 100 lb. Rail, Rate 26 ft. Per Minute

speed by pushing the "fast" button. On wheel lathes not using this electrical equipment the entire wheel must be turned at the slow speed at which the hard spots can be cut. It is therefore apparent that both the motor drive and automatic control are desirable on this class of machine.

Arrangement of Machine Tools

One of the greatest inherent faults with present railroad shops is the congestion of machine tools in poorly lighted bays brought about by the adherence to the group drive. This condition holds up the output of the entire shop, and for this reason one of the best ways to increase the entire shop efficiency is to shift the machine tools wherever necessary in the interests of the best grouping of the work, and to allow more room for the operator, for the handling of materials and for the working of cranes.

Motor Driven Auxiliaries

Machine tool production may be materially increased and a considerable saving in time made by the use of electric driven labor saving devices on machine tools, such as electric driven carriages, head stocks, cross rails, etc. After a man has moved the lathe carriage back and forth several times he is ready to rest, with the result that considerable time is lost, due both to the slower action of the hand operated carriage and the fatigue of the operator. Most large planers and boring mills already have power operated auxiliaries, but on heavy lathes this point is ordinarily overlooked and this suggests a place where a simple improvement will increase the production with the same or less labor. On all modern wheel lathes, even where the center is moved only six inches, the present practice is to "do-it-electrically." Such applications can readily be made on old manually operated auxiliaries.

The small electric hoist should be used with all tools which handle heavy work. The use of such hoists will result in considerable time saving due to their quick action and will eliminate the loss of time due to the fatigue of the operator. Electric hoists are much faster than chain hoists, and are more convenient and take up less space than air hoists. Small monorail electric cranes also handle materials efficiently and quickly. Electric trucks are particularly necessary at this time when there is a shortage of labor, although they add greatly to the shop efficiency and production under any conditions. Their manufacture has now become so standardized that their reliability and economical performance is unquestioned.

Electric portable drills are more easily handled and more economical than air drills; ordinarily not enough of them are provided in the railroad shops. Portable electric boring bars are also important additions to any railroad shop equipment. Their mobility and general all-around usefulness makes them a popular tool. The electric lifting magnet can also do its share toward increasing the efficiency of the shop.

A 500 lb. Electric Hoist Removing a Gear from a Lathe

Other applications of electricity to railroad shop equipment include electrically operated transfer tables and electric gantry cranes in the shop yards for handling heavy material of all kinds. By their installation gangs of men are released that can be used for other purposes or which may be entirely dispensed with. This also holds true for electrically operated turntables, which are speedier and easier to handle than the manually operated ones.

The subject of the general application of electric motors to railroad shop tools and machinery should not be left without referring to the economy effected by their use on coal dock hoists and water pumps at all places on the line where current is available at a reasonable rate.

Spare Motors

Assuming that the continuous operation of a railroad shop, coal dock or pumping station, etc., is essential, and it is undoubtedly more so now than ever, it is good insurance to provide a suitable number of spare motors and motor parts. It is the general policy of the average railroad to divide up the purchases of motors between the various well known motor manufacturers. For this reason it has generally happened that there are three or four or even five makes of motors in one shop. Such a condition not only complicates motor control from the workman's viewpoint, but also makes it expensive and difficult to keep sufficient spare motors and repair parts on hand. All the motors in any one shop should be of the same make.

Electric Welding

The great savings and economies which may be effected by the use of arc welding are not fully appreciated generally by railroad officers. The variety of the work that may be done with the electric arc welding outfit is usually a revelation to those not familiar with the process. This work may be roughly divided into four classes—straight welding, building up worn parts, boiler work and cutting.

Welding a Broken Locomotive Side Frame with the Electric Arc

Straight welding with the electric arc is a fairly simple operation and is better understood by the average railroad man than any of the other three applications. The building-up process, however, is rapidly becoming the most widely known and useful of the processes in that it can be used for an almost unlimited number of jobs. Practically every steel casting on a locomotive or car is subject to wear; this formerly required the ultimate replacing of the part in question. By electric welding the worn surfaces may be built up and then machined down so that the parts may, with slight expense, be made practically as good as new.

More and more boiler work is being done with the electric arc, such as welding in patches in the firebox, building up the mud ring, welding in the flues, etc. Firebox troubles, such as cracks, leaky staybolts, etc., are easily repaired by the electric arc process. The welding of broken locomotive frames may also be done quickly and cheaply. One large railroad using this method of repairing locomotive frames reports that during the two years it has been used not one of the frames has failed at the weld. As such welds are made without dismantling the locomotive the economy is apparent.

Cutting out pieces of steel of various shapes with the electric arc is not yet a common practice on most roads. It is a great improvement over the drilling process in that it is considerably faster and it is possible to cut around regular or irregular shapes with equal facility.

In one of the largest locomotive shops in the country during a period of seven months, and with a current cost of two cents per kilowatt hour, the net saving by arc welding

Night View of a Modern Railroad Machine Shop Taken with Artificial Illumination—All Tools Have Individual Motor Drive

methods per month was $1,375.18. Other figures supplied by a large railroad are of interest. These arc welding costs are based on a power cost of 51 cents per hour with a carbon arc, and 17 cents per hour with a metallic arc, together with a labor cost and overhead charge of 40 per cent. The costs are taken from actual jobs and give the cost of welding compared to that of putting the apparatus back into service by some other method:

Operation	By welding	By other methods
Welding tender draft castings	$1.11	$18.31
Building up flat spots on locomotive drivers	.40	225.00
Repairing mud ring	5.75	32.70
Repairing eccentric straps broken through the neck	1.08	41.28
Welding one driving box broken through the crown	5.75	39.31
Repairing firebox	124.89	869.58
Welding three spokes on driving wheel	11.20	126.60

A Well-Lighted Shop. Production Is Restricted, However, Because the Belts Will Not Pull the Heavy Cuts Possible with Direct Connected Motors

Illumination

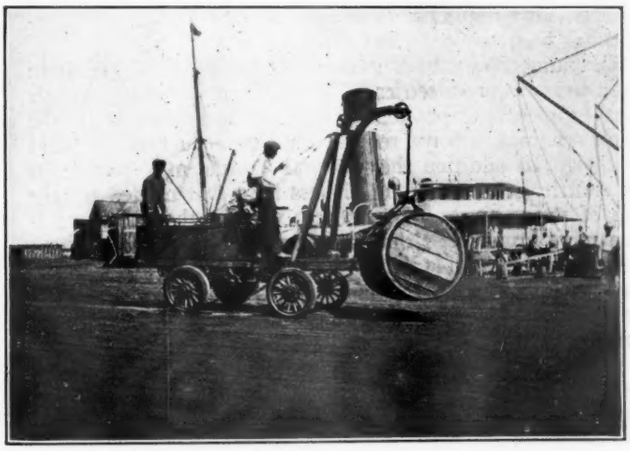
One of the most effective ways of speeding up the production in any shop is to provide proper and adequate artificial

illumination, which based on the present accepted practice involves the use of a large number of high capacity incandescent lamps mounted in suitable reflectors. Good illumination produces a cheerful atmosphere, prevents accidents, insures rapid and accurate work and in many other ways increases the efficiency of the shop. The general trend in modern shops is to provide angle reflectors at the sides

Gantry Crane Unloading Cars in a Railroad Yard

of the bay in addition to the regular overhead units so that sufficient side lighting will be insured. It is also considered good practice to install extension cord outlets on all machine tools where inside work is likely to be done.

The following comments on the relation between illumination and efficiency are taken from Technical Paper 102, Department of the Interior. "The most enthusiastic supporters of proper lighting for shops are those who have taken the steps to insure it and have seen the benefits thus derived. Increased efficiency varying from two to ten per cent has been reported as a result of improved lighting conditions.



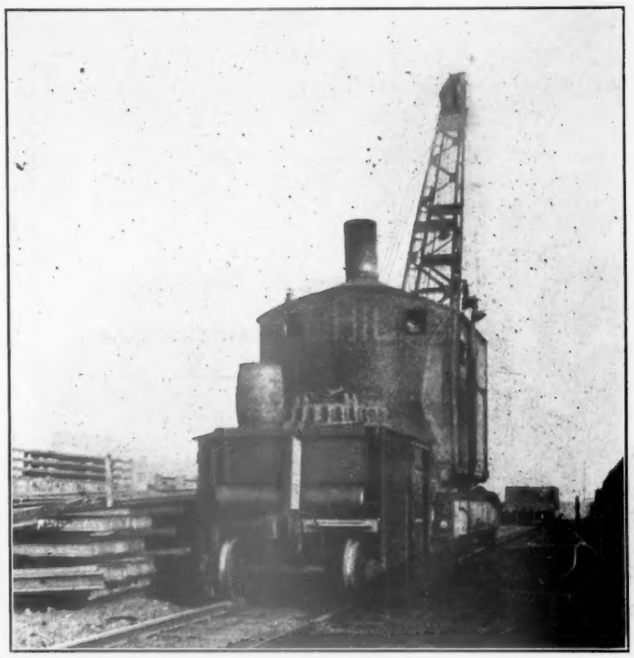
Electric Crane Truck Moving an 1800 lb. Tobacco Cask 1000 Ft.

The ill effects of bad lighting, such as impairment of eyesight, depressed effects on the worker and his resultant attitude toward his work and his employer, should also be considered."

The classification yard is another place where an adequate installation of artificial light will result in a noticeable speeding up of the number of cars handled at night. It will also operate to keep down repair costs to rolling stock and freight and will prove a most efficient accident preventive. Complete specifications for the best known methods for lighting classification yards were included in a committee report of the Association of Railway Electrical Engineers published on page 520 of the October, 1916, *Railway Electrical Engineer.*

Protective Lighting

Since a short time before the outbreak of the war another application of artificial illumination to railroad buildings, yards, bridges, etc., has come into prominence—protective lighting. The aim is to throw the light upon the object to be seen. A bright light in the field of vision makes it difficult to see an object of decidedly lower brilliancy, as, for example, a man dressed in dark clothing, in the same visual field. Glare must be avoided. Glare is a result of a light source extremely bright in respect to surroundings located directly in the field of vision. It is best overcome in the case of protective lighting by mounting the units so that they are considerably above or below the ordinary angle of vision and by shading the lamps by suitable reflectors. In any form of emergency lighting where the installation is considered as temporary there is a tendency to mount the lamps on any convenient pole or structure that may happen to be available without thought to the illumination result. The lamps in



Locomotive Crane in Railroad Terminal Yard Equipped with Electric Lights and a Lifting Magnet. Current Furnished by Oil Engine—Generator in Special Car Coupled to Rear

the line of vision tend to blind the guards so that they cannot see any object either in front of or beyond the source of light. Another principle that should be observed is to place the lighting fixtures or projectors in such a way that the light will be thrown away from the guards themselves so that they will not be sharply outlined for the benefit of the enemy they are supposed to guard against.

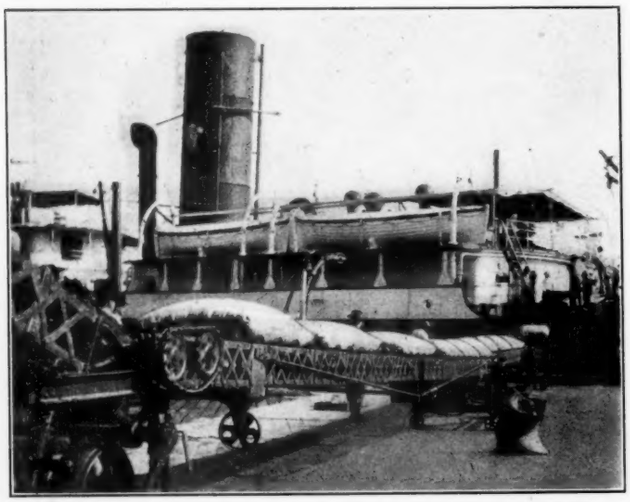
Current for the protective lighting of shops, yards, and other places is usually available from existing feeders. For bridges, however, which are often a considerable distance from any town or shop, portable lighting units, usually gas engine driven generators, must be used. Where a steam pumping plant or other steam boiler is located nearby it is possible to use one or several small headlight turbo-generators.

Electric Equipment for Freight Terminals

Freight terminals are generally recognized as the points of congestion which limit the capacity of a railroad. The han-

dling of freight in large terminals can be roughly classified under two divisions, first, the loading and unloading of cars at the freight houses and on the team tracks, wharfs, etc., and, second, the shifting of the cars themselves in the drilling and classification yards. For both classes of work special electrically operated machines have been developed.

For handling package freight there are the electric portable conveyors, the electric truck with its trailers, the portable dock winch, the electrically operated conveyor crane, electric locomotive cranes, etc. One truck has been developed which is a combination storage battery crane and tractor, with a hoisting capacity of 4,000 lb. and a drawbar pull of 2,500 lb. Any of these devices are obviously a great improvement over the slow, cumbersome and expensive man-truck method of handling package freight and are indispensable if it is desired to handle the freight in and out of the cars with a maximum speed. The most efficient package freight electric conveyors for use around freight terminals are those which are portable as compared with those which are fixed. By portable machinery is meant devices that may be moved about, self-propelled or otherwise handled with or without rails. The use of a relatively small number of portable dock hoists or conveyors rather than a large number of fixed ones is becoming standard practice. A most satis-



Portable Electric Conveyor Carrying 60 Tons of Coffee an Hour From Ship's Deck to Storage Piles

factory control is the automatic where the control panel is mounted on the machine but the master controller is carried by the operator who has a range of 100 ft. radius, or more if necessary, thus permitting him to stand on the deck of a boat, in the car, or in the freight house while the conveyor is operating.

Several electrical devices have been developed for speeding up the work in the yards. One of the most important of these is the electric locomotive crane which is always ready to begin operations on a moment's notice at any time of the day or night. The operator is not required to have any knowledge of the care and maintenance of a steam plant and does not have to devote any of his time to firing. The maintenance cost of an electrically operated crane is considerably less than that of a steam crane, as there is no boiler maintenance and no fire, water or gas to handle. The control of the electrically operated crane is also much simpler than that of a steam crane in that it can be made entirely automatic. In the latest types of electric locomotive cranes the operator stands at the front of the machine near the base of the boom and controls all movements of the crane and the boom by simply pressing buttons.

In a large railroad yard near New York where steam locomotive cranes are used, a small trailer is attached containing an oil-engine driven electric generator which supplies current for illuminating the area around the crane and for an electric lifting magnet which is used to handle certain classes of freight. The electric fixtures for illuminating the working area are attached directly to the boom and cab of the crane, and in this way the installation of an extensive yard lighting system is avoided.

A recent development for speeding up the switching in large railroad yards is being worked out by a railroad in conjunction with an electrical manufacturing company. This contemplates the use of a large gantry crane, which will be designed to have a span of five tracks with a two-track overhang at each end. It will be used to lift a car up bodily from a main line train, transfer it across intervening tracks and set it down on another track in a distributing train. The purpose is to avoid the switching now necessary when making up a train. The railroad for which this crane is being developed has a pier in an eastern seaport which will accommodate 72 cars a day, but which can under present conditions seldom get over 45 cars a day because of congestion in the yard.

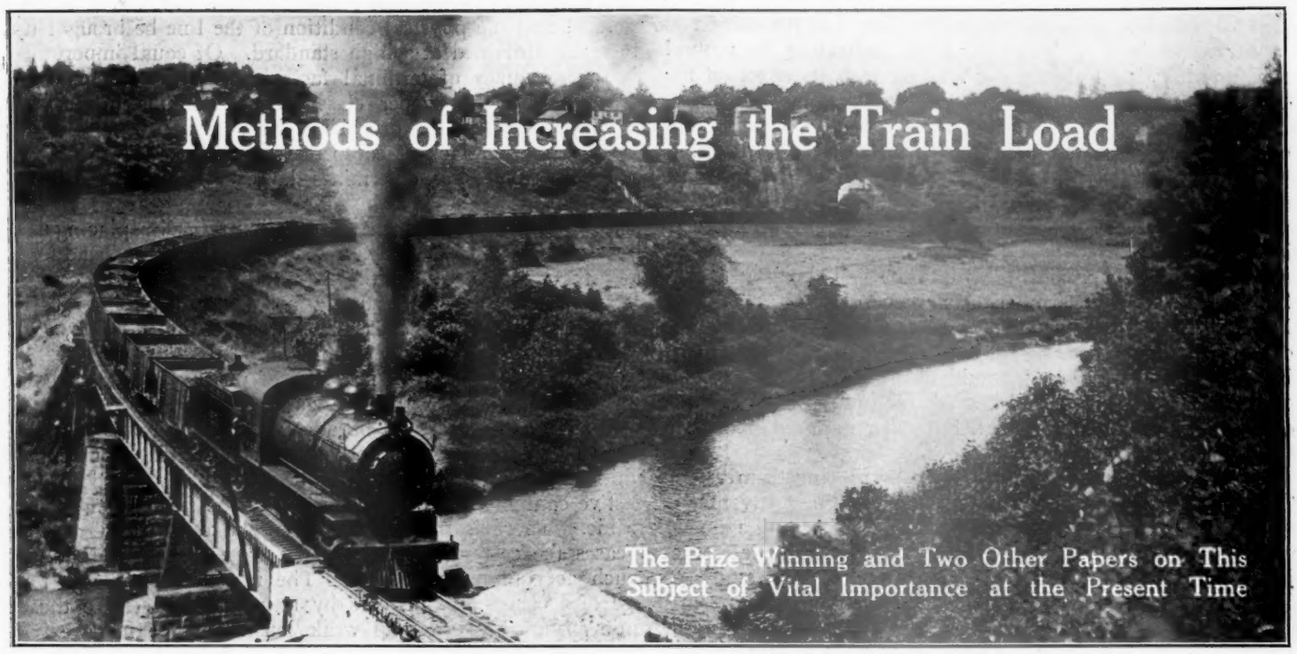
Electric Traction

It would hardly be consistent in an article of this kind to conclude without mentioning the efficiency of electric traction as compared with steam operation. The speeding up of traffic and the increasing of the capacity of a congested railroad by using electric locomotives is no better illustrated than on the Norfolk & Western. In a paper recently read before the New York Railroad Club by C. H. Quinn, electrical engineer of that road, it was pointed out that under steam operation the average miles per day would approximate 60 per locomotive. This mileage, with electric locomotives, has been increased to 100, with only a slight increase in time per day for the train crew. The short terminal layover for the electric locomotive, which averages 45 min. per locomotive, practically permits the Norfolk & Western to double crew these locomotives every 24 hours. As a direct result the number of locomotives handled out of Bluefield has been reduced from 17 steam to 5 electrics.

The number of pusher locomotives has been reduced from seven steam to two electrics. Electric locomotives during fair weather operate at practically full tonnage rating while the steam engines always require tonnage reduction in cold weather. In addition the terminal equipment required for the electric locomotive is much less than that needed to take care of steam power. In freezing weather the difference is even more pronounced than at other times.

Another remarkable demonstration of efficiency of electric operation as compared with steam is the electrification of the Chicago, Milwaukee & St. Paul over its mountain divisions. With the introduction of electricity this road is able to double the cruising radius of its locomotives. As far as the railroad is concerned the division point of Three Forks, Mont., has been eliminated entirely so that all locomotives run the entire 226 miles from Deer Lodge, Mont., through to Harlowtown, Mont., with only a slight inspection of bearings and pantagraphs at the intermediate point of Three Forks. The shops and roundhouses at this point are entirely closed down, seven or eight miles of track have been removed and the roundhouse force previously employed has been replaced by a single electrician.

Railway Construction in Western Australia.—During the last four and a half years the government of Western Australia has constructed 1,000 miles of new railways, and, in continuation of this progressive policy, has decided to immediately commence the construction of the railway from Kondinin to Merredin (85 miles). It has been announced that the Transcontinental Railway will be opened early in September.



Methods of Increasing the Train Load

The Prize Winning and Two Other Papers on This Subject of Vital Importance at the Present Time

THE contest on the subject of Increasing the Train Load was announced in the *Railway Age Gazette* of February 2, two months before the United States entered the European conflict. This contest was planned because of the importance of the subject to railway men as a means of promoting economy of operation during peace times. The entrance of our country into war with the prospect of an even greater tax on the railways than that of the past year, makes the full loading of trains and the conservation of motive power of even more interest and importance than when the contest was first announced. For this reason the two prize winning papers and two others which received special mention are published in this issue. Other papers received in this contest will be published in later issues.

Twenty-nine papers were received in the contest. Most of them were prepared by superintendents, train masters and other officers in the operating department, although the engineering and traffic departments were also represented and two papers were received from men connected with universities. Several of the papers were received as the direct result of the co-operation of the American Association of Railroad Superintendents, which organization called the contest to the attention of those of its members especially interested in this subject.

The papers were turned over to J. A. Gordon, general manager, Chicago Great Western and W. S. Williams, terminal superintendent, Illinois Central and president of the American Association of Railroad Superintendents. Although it was difficult to make a final choice between several papers, they have awarded the first prize to M. A. Simmer, statistician in the general manager's office of the Boston & Maine, Boston, Mass., and the second prize to Edwin Winfield, of McGill University, Montreal, Can. Special mention was also given to the papers prepared by W. M. Whitenton, trainmaster on the Missouri, Kansas & Texas at Muskogee, Okla., and by A. G. Smart, division superintendent, Chicago, Burlington & Quincy, Beardstown, Ill. These four papers are published below.

M. A. Simmer

FIRST PRIZE—TRAIN LOADING MEANS CAR AND LOCOMOTIVE LOADING

By M. A. Simmer,
Statistician, General Manager's Office, Boston & Maine, Boston, Mass.

The increased freight train load has made financially possible the movement of traffic at stationary or declining rates in spite of the rising trend of expenses and has increased the capacity of the line, effecting a postponement of the necessity for additional main tracks. The feasible lines of developing the train load are through the expenditure of capital in improving the plant and increasing its capacity, and through the more economical and efficient use of the capacity. The latter means can be divided into two parts, the capacity loading of cars, and the capacity loading of locomotives.

Car Loading

Only about one-half of the available car capacity of the country is actually utilized in loading and if coal-carrying equipment is eliminated the difference between the total and the use capacity is still greater. Some of the practical means of reducing this difference are suggested below.

Careful supervision and a spirit of co-operation by everyone connected with the loading and handling of cars, are essential factors making for the fit condition, proper loading, intelligent distribution, advantageous routing and otherwise economical handling of equipment.

Cars must be in good condition to render the best results. Proper inspection before loading is necessary to see that cars are fit for a particular lading; and before being made up in trains for movement, it must be determined whether the cars are capable of withstanding the strain to which they will be subjected. The overloading of cars is as wasteful as the underloading. The tendency to do either should be discouraged.

The loading of carload freight is largely under the control of the receivers and shippers. It is, therefore, their co-op-

eration which is the necessary means for solving in large part the problem of increased car loading. If the subject is submitted to them in the proper light, indicating the mutual benefits attaching to better car loading with its effect on the car supply, increased terminal capacity, expedited movement, etc., a substantial improvement should result. The minimum car load weight is the limiting factor of capacity loading. Co-operation between the shipping public and the railways should make possible, however, some increases in minimum weights, which will not be unduly burdensome to commercial interests.

A study of the possibilities of better l.c.l. loading at the freight house may determine the practicability of consolidating into one car an increased number of shipments in lieu of making straight cars. This development, in addition to increasing the car loading, would also be an effective means of reducing the dead weight hauled, facilitating the handling of cars on account of the smaller number required, reducing switching charges, etc.

The intelligent distribution of cars by placing them where their particular capacities may be utilized to best advantage, contributes greatly to increased car loading and reduces waste. The car of large capacity should be given preference for the long haul. There is much to be gained by study to determine where the routing of loaded cars could be so improved as to give the company the advantage of long hauls. As the heavily loaded car rolls easier than the lightly loaded car, the added advantage attaching to better car loading in its effect on the train load, is obvious.

Locomotive Loading

After the most economical car loading and the best routing of cars have been attained, effort should then be directed towards increasing the train load by maintaining the established rating for the drag, time, stock and perishable freight trains in the direction of maximum business. This can be accomplished by the careful supervision of all the details incident to train loading and operation, and by co-operation generally. The performance of trains should be scrutinized daily so that the tonnage moved per train may be closely adjusted to the engine rating in the prevailing direction, thereby stopping those small leaks which are not uncommon in train loading.

The growth, volume and character of freight offered for transportation are the great factors influencing the train load. There is usually a direct relationship between traffic density and train load, and as the district traversed by a road develops, the train load should ordinarily respond to the growth in business.

Development of long haul business is an important agency in stimulating the train load. The matter of reducing the ratio of unbalanced traffic—empty car miles—by developing a class of tonnage in the light direction moving in large train loads so that the empty equipment can be used for return loading, is important. Although possibilities in this direction are limited, the subject deserves attention as the increase in the train load on some roads where a heavy train load obtains is directly attributable to this means of reducing empty car mileage. The matter of routing cars to give the minimum empty car mileage should also be considered.

Track capacity and train load are very closely allied. In order to increase the train load, track capacity must be sufficient, while an increase in track capacity is effected by the larger train load. The matter of increasing the number of sidings, or extending or better distributing them, the installation, extension or closer location of block signals, the better arrangement of water stations in relation to station stops, or making them accessible to trains while standing on passing tracks, etc., may be considered as an aid in expediting the movement of traffic and incidentally increasing the train load.

To accomplish the best results in train loading, it is important that the physical condition of the line be brought up to and maintained at a high standard. Of equal importance is the adequacy of terminal facilities and the efficiency of personnel in the proper classification and making up of trains and otherwise preparing them for road movement. Co-operation or lack of co-operation between the yardmaster and the despatcher determines largely the destiny of the train load.

The proper arrangement of cars in trains by placing the heavily loaded—especially the steel cars—at the head end and the wooden cars at the rear—not between steel cars—is an effective means of actually increasing the engine rating, with less pulling out of drawbars with resultant delays, and the trains are more easily handled.

The good condition of power is of primary importance in considering advantages to be gained from increased train loading. Facilities must be adequate, however, to properly care for the locomotives and cars. A sufficient number of units in good condition should be available so that no defective equipment is allowed to hinder the free movement of traffic. There is nothing that demoralizes the service, increases the cost of operation and reduces the train load as much as equipment failures. The matter of reducing the age of locomotives and cars by retiring from service those units of low capacity and weak construction which are incapable of performing economic service, should be considered.

A study of the assignment of power to the main line is very important in order to determine whether its capacity is adequate to meet the service conditions and requirements of the traffic over the district. The assignment of locomotives released from the main line, to branch lines, should also be given careful attention in order to place them where they will be most effective in reducing train mileage.

It is important that the rating of locomotives be so fixed that the trains will "get over the road" with a minimum of delay, if economies are to be realized. The waste attaching to the overloading as well as the underloading of locomotives should be appreciated. The value of a dynamometer car in recording the work performed by a locomotive over a given district and establishing the most economical rating is recognized. It has been the means of increasing considerably the tons per train. After the relative ratings for the different classes of power for the respective engine districts, ruling direction, based on various physical, traffic and climatic conditions, have been established, they should be closely observed so that the margin between the potential and the actual train loads, which is usually very much in evidence, may be reduced.

The classification of cars for movement as solid train loads will give the best results in train tonnage. After a train has been properly prepared for movement, its fortunes are largely in the hands of the despatcher. Efficient train despatching makes for increased track capacity and, incidentally, increased train tonnage. In order to reduce as far as possible light train movements, the practice of filling out fast freight trains with dead freight, where their schedules would not be interfered with, should be followed. While the way freight should not be made a tonnage train, a study of its work and the time in which it can be performed may show where the local can be filled out with additional tonnage to good advantage.

The possibility of introducing or rearranging existing helper or pusher service, and the running of turn-around trains over portions of a district, where the engine loading is unbalanced, then setting out these trains and using the tonnage to fill to capacity trains over a lighter portion of the road, may also be considered.

On roads of two or more tracks the better arrangement of train movements or the use of one track for drag freight only, may result in further increased economies.

Expedited service, due in part to the character of freight handled, and in part to competition, influences the train load largely. Co-operation between the traffic and operating departments in revamping the fast freight service may remove some of the restrictions to heavier train loading with a resultant increase in track capacity. A study may develop where schedules under competitive conditions could be lengthened without the loss of much *net* money, especially where heavy equipment, such as refrigerator cars, must be lightly loaded in the governing direction, run at high speed with consequent delays to other trains and return empty, which reduces materially the revenue per train.

There exist on many roads locomotives which have passed the economical stage, owing to their light capacity, which precludes the hauling of sufficient tonnage to compensate for the higher expenses. On such roads there are abundant opportunities for increased economies by modernizing them through the application of superheaters, brick arches, etc. Where this practice has been resorted to, it has netted a large return on the money expended.

Where greater tractive capacity is desired, further economies can be secured without prohibitive cost by converting the existing Consolidation engines into Mikados, involving a lengthening of the fire boxes and applying trailing trucks. Where traffic conditions warrant, further economies can be realized by the introduction of power of still greater capacity. The adoption of heavier power, however, involves improving and enlarging the line and terminal facilities and necessitates improved shop facilities to accommodate and properly care for the larger units.

Where heavy grades are encountered, electric motive power has furnished the necessary relief from congestion in lieu of relocating that part of the line, and has increased the capacity of the line and incidentally the train load. The superior efficiency of electric locomotives compared with steam is recognized.

Where the volume of traffic warrants it, and where practicable, elimination of grades and curves, intelligently done, should yield the greatest single economy in train loading. On branch lines of heavy tonnage, an improvement in roadway and structures may make for a further reduction in train mileage.

As a means of further increasing the track capacity, and incidentally the train load, the construction of an additional main track may be considered a big factor.

SECOND PRIZE—ALL DEPARTMENTS CAN HELP INCREASE TRAIN LOADS

By Edwin Winfield,
McGill University, Montreal, Que.

Briefly stated, the ultimate measure of efficiency in transportation is expressed in terms of ability to move the greatest revenue tonnage at the least possible cost. Applying this axiom directly to our railroad systems, it ought not to require a great deal of explanation to demonstrate to anybody that a big trainload is desirable.

It immediately follows that it is necessary to secure the maximum carload; that is, the tonnage should be increased with revenue freight, not dead weight. The good old maxim, "First load your cars; then load your engines," is as true as ever.

Nine suggestions on car loading may be offered. First, if all the freight for one point can be put in one local car, there is little use in loading it in two. Second, if a shipper orders a car, the agent who is alert will find out what he wants it for, and will not be guilty of sending him a 100,000 lb. capacity car for a ten-ton shipment, if he can help it. Third, taking into consideration the varying kinds of commodities and the different types of cars in use, an effort must be made to have the ratio of space capacity to weight capacity suitable for the proposed loading. Fourth, cars for the different stations on way freight runs must be well arranged; for if by a shifting of station grouping, one car can be cut out, economy is certainly effected. Fifth, those in charge at freight houses must continually insist on the proper stowing of package freight; small savings count up. Sixth, the efficiency of the car service forces in the proper distribution and handling of cars is all-important. Seventh, the condition of maximum carloads would probably be more nearly approximated by the use of loading inspectors, whose sole duty it would be to see to efficiency in loading. Eighth, some special inducement should be held out to each agent to secure the best average loading at his station over a given period. Ninth, the importance of maximum carloading must be emphasized to the shipping public.

Owing to the unbalanced traffic conditions existing on the great majority of roads, it will be recognized that the preceding paragraph applies primarily to the direction of heaviest traffic. From the very nature of the case, however, it is evident that the maximum carload is all-important. In fact, it is the crux of the whole situation. If cars are not loaded, all attempts to secure a maximum trainload are utterly useless; therefore, efforts should be directed to securing the best car loading possible.

Another fundamental principle is the distribution of power, including helpers, on the different engine districts of a division. This, however, is a matter of such outstanding importance that it is universally recognized. In the operation of trains, delays arise, from causes innumerable. At first sight it would not seem that these should affect the actual tonnage taken but as a matter of fact these delays call for a higher rate of speed, to compensate, and inevitably give rise to a tendency for a correspondingly lighter loading. First, there are terminal delays of various kinds. Yardmasters, train-masters, and despatchers can often obviate these altogether by getting together. Second, there are delays due to mechanical imperfections in cars and locomotives. These will be discussed later. Third, there are delays due to poor despatching, particularly bad features being excessive stopping of heavy drags for "31" orders, and the "freezing up" of long trains on passing tracks in cold weather. The disease suggests the cure. Fourth, there are delays due to defects in block signal systems mainly lack of facility for following movements on single track. Modern systems are doing away with these and it is being recognized that a bigger train can often be taken over without a helper simply by the installation of so-called "tonnage" signals at critical points. There are various other sources of delay too numerous to mention. The point is, however, that any delay indirectly acts to reduce the tonnage, and steps should, therefore, be taken to obviate it at once.

The importance of water purification, in relation to the railway business is not so well recognized as it should be. The effect which carbonates, sulphates and corrosive acids in boiler water have on tonnage capacity would be surprising to many. By decreased steaming capacity it makes necessary direct tonnage reductions in addition to the many other items of expense arising from this cause. In many cases, a comparatively small outlay for purification plants will be a paying proposition, and a great increase in train loading can be effected. There are many other improvements in locomotives which directly affect hauling capacity as the power reverse, mechanical stoker, brick arch, superheater, etc., the last two of which should certainly be adopted by every progressive road. The chief advantages are in savings, but an increased tonnage rating is also a result. It seems likely that powdered fuel will also prove to be a great improvement. An increased trainload is a logical outcome of the adoption of all scientific improvements of which the above are examples.

A man pushing a loaded wheel-barrow can make better

time over a concrete walk than through a swamp, which observation leads to the fact that the maintenance of way department can help increase the train load. A dynamometer car will show some strange results corresponding to variations in track conditions. The way in which the draining, lining and surfacing are done will certainly have their effect on train resistances. A soft wet roadbed will give a starting resistance and velocity resistance much greater than one properly maintained. Proper super-elevation on curves cuts out a lot of curve resistance, which should not run above 0.7 lb. per ton per degree. The track should be specially well kept up on sags, where engineers can "open her up for a run at the hill." Prompt and efficient snow removal is necessary. The better the track is kept, the smaller is the tractive effort required to overcome unnecessary train resistances, and the greater will be the tonnage which can be handled.

Let us now regard the subject from the viewpoint of locomotive operation and maintenance. The proper training of firemen, often sadly neglected, is an important thing. The fireman's performance—speaking of the general performance of the firemen of the road, as a class, during a considerable period of time—is bound to have its effect on the tonnage handled per train. The same applies to engineers in the handling of the locomotive. Contributing factors are a proper knowledge of the machine, lubrication, air-brakes, etc. Thus the engine-crews, locomotive foremen and road foremen of locomotives can do their bit in the general movement toward securing the maximum trainload.

Proper supervision and execution of the work in the repair shops is evidently necessary. Every man in the maintenance of equipment organization is a factor in the problem of increasing the trainload. The hauling capacity of locomotives is as directly affected by the work of the valve gangs, and guides and cylinders gangs, as it is by that of the boiler and wheel gangs. That which holds true of the shop forces in connection with general repairs holds true of the roundhouse forces in connection with running repairs. The direct and favorable effect on the trainload of such things as frequent boiler washing, proper lubrication, reliable injectors, properly set up wedges, properly keyed brasses, tubes that don't leak, and so on, is evident.

Again, the importance of proper maintenance of cars in relation to the train tonnage is apparent. Trains made up of "twenty cars of freight and ten cars of slack" are a poor proposition, and the continual pulling of draw-bars certainly will never create a general tendency to take bigger tonnage. Smooth riding trucks, good journal bearings, and proper lubrication are a big factor in train resistance, and anything which will decrease the resistance, proportionately increases the trainload which can be handled.

Looking at the matter from the standpoint of the yard forces, further opportunities for securing the maximum tonnage are apparent. In the first place a thorough terminal test of the air must be made. Often a train crew asks for a reduction of tonnage; on examination, the brakes will be found sticking on several cars carelessly passed by. Second, a scheme of tonnage rating and empty car compensation based on scientific principles must be adopted and lived up to. Third, weather reductions from standard rating in the make-up of trains must be closely watched, and the reduction made for probable conditions at the ruling grade, not at the departure terminal. Fourth, the loads should be placed at the head of the train. This makes a much easier pulling train, particularly on a division with much curvature and a "choppy" profile. Fifth, the exercise of reasonable care in switching will keep the cars in better condition. Sixth, a rigid inspection of all trains will ensure favorable conditions for maximum tonnage.

The purchasing department also is not without power to help in the general movement. The quality of coal put on the tenders will have a great deal to do with the case. It is desirable to have lubricating oil that will lubricate; piston and valve stem packing that will pack, and so on down the line. In the long run, the quality of the material given to the men with which to carry on operations will have a big effect on the average tonnage per train.

It would seem that the duty of the executive officers is to enforce the observance of all the things that tend to produce better operating efficiency, and, with better operating efficiency, the increased trainload, and it certainly requires a great deal of planning to enforce them all. The statistical branch of the accounting department at headquarters must, in connection with the line officers, be called upon to furnish statements and reports on such things as engine failures, fuel consumption, and other important operating details. If these are issued promptly, and studied and acted on promptly, bad conditions can be done away with. If, as is too often the case, long strings of statistics are made up a month late, and are never looked at, they are useless. A continual study of traffic conditions, the possibility of securing back loading, and the freight movement generally, will enable trains to be so scheduled as to obtain larger average trainloads. With efficiency encouraged and enforced in every department of the work, as indicated in preceding paragraphs, an increased trainload, limited only by the profile of the road and the available tractive effort of the power in use, will follow automatically.

By the very nature of things, there is going to be some point where it will be uneconomical to increase the loading of a given locomotive in a given direction over a given engine district. The general impression seems to be, however, that the best loading is that which will just enable the locomotive to operate over the ruling grade. In numerous cases, due to the effects of many varied conditions, this impression is erroneous. But, leaving these finer distinctions out of account, there is no doubt that the largest trainload which the locomotive can handle over the ruling grade should be aimed at, and that economy of operation will be greater the nearer this condition is approximated. It should also be borne in mind that the most important part of loading engines is to first load the cars.

ATTENTION TO DETAILS BRINGS RESULTS

By A. G. Smart,

Superintendent, Chicago, Burlington & Quincy, Beardstown, Ill.

In view of the universal increase in transportation costs, the necessity for increased efficiency in operation is apparent, and as the cost per ton mile is, in the last analysis, the measure of efficiency, the loading of trains is a factor of the utmost importance. While reducing grades and increasing the size of motive power brings results in this direction, the expense involved is great, and a decided increase in the train load must be secured to justify the expenditure. Close attention to details, if intelligently and persistently followed up, will bring surprising results even without changes in grades or motive power.

The net tons per train mile on numerous roads is so low that the addition of one loaded car per train will increase this figure approximately 10 per cent, and an addition of less than two tons in the loading of each car in the average train on such roads will produce the same result without adding to the number of cars. There is a breaking point where the increased cost per train mile makes it uneconomical to further increase the train load, but this is decided by the local conditions peculiar to every freight district and no hard and fast rule of general application can be established. This limit can only be ascertained by careful experiment in actual service.

It is essential to secure the highest possible proportion of

net to gross weight in each loaded car. Low capacity and lightly loaded cars are an unmixed evil. It is just as expensive to handle a tare weight that brings in no revenue as revenue producing freight. Hence the necessity of following up the loading of cars at freight houses and industries carefully, to the end that two cars will never be used where one will suffice.

The condition of locomotives must be such that maximum results can be reasonably expected; consequently the round house forces must be given sufficient time to do all necessary work before engines are returned to service. When power is in urgent demand there is a great incentive to press the engines into service without giving them the attention necessary to insure dependable performance, but this leads to failures on the road, reduction in tonnage, and delays to traffic and instead of improving the situation, makes it much more difficult to handle.

Engines should be given all necessary tests to ascertain the maximum tonnage they can handle successfully over the division at the speeds required, and then every effort should be made to see that they have this rating every mile they run.

In terminal yards the train should be made up and the air tested before the road engine is coupled on, so that any cars with defective train lines or inoperative brakes can be removed, and replaced with other cars before road crews take charge of the train. Road engines should be equipped with double pumps and a sufficient main reservoir capacity to insure the proper charging of train lines promptly and to avoid the friction of brakes not fully released.

In starting at terminals, train crews should be required to station a man at the head end of the train to inspect each car as it passes for train line leaks and sticking brakes, and at every stop en route, so far as possible, examine the train for incipient hot boxes and other defects. By starting one man from the head end and one from the rear, changing where they meet, and returning to their respective positions on the train, such inspection can be made quickly, many delays will be avoided, and the foundation will be laid for a successful trip.

At intermediate repair points, sufficient tonnage should be assembled to replace any bad order cars through trains find necessary to set out, but train crews should be required to use all means in their possession to take care of hot journals and minor defects that develop en route, and avoid the necessity of setting out cars between terminals. Train crews can frequently rebrass and repack boxes in less time than would be required to set out the car, and if there is always a car to pick up when one is set out, the number dropped en route will show a decided decrease.

Where one ruling grade limits the engine rating, a turn-around run, to the top of the hill will enable through trains to obtain maximum rating beyond this point. If business is insufficient to justify turn-arounds, the desired end can frequently be gained by giving engines a doubling train over the ruling grade. A 5-mile hill should not be permitted to regulate the engine rating over a 100-mile district. The loading of way freight trains should not be overlooked. By having them assemble through cars and place them for through trains, at points where the grades beyond permit handling heavier tonnage, the tons per train mile may be increased on both classes of trains.

Where there is a heavy empty movement and the car limit of trains enters into the question, a sufficient number of loads should be handled in each train to bring the gross tonnage of the train as near the engine rating as practicable. Every net ton so handled adds to tons per train mile, and to that extent increases the operating efficiency.

It should be a maxim that no trains are to be run in the direction of traffic with less than engine rating for the class of train involved, avoiding the use of extra trains until assured of full rating for all scheduled trains, and in case of light traffic, consolidating regular trains where the nature of the business will permit.

The number of fast trains, where tonnage is sacrificed to obtain speed, should be kept at the lowest possible minimum consistent with the proper movement of the traffic. In loading such trains there is but little necessity of going very far below the maximum ratings, unless the schedules are exceptionally fast. Efficient despatching will assist materially. Fast freight trains fail to make their schedules more frequently on account of delays than on account of the tonnage handled, and the public prefers a dependable service at reasonable speeds, rather than a very fast, but irregular service. Prompt handling of cars after arrival at terminals will also help to make extremely high speeds on the road unnecessary.

The secret of successfully handling heavy tonnage trains within reasonable time limits is unimpeded movement. Adequate facilities at terminals, passing tracks at convenient points, and coal sheds and water tanks properly located, are essential.

A PROGRAM FOR THE SUPERINTENDENT

By W. M. Whitenton,
Trainmaster, Missouri, Kansas & Texas, Muskogee, Okla.

Wellington, in describing the object of transportation, said: "Get all the business possible, save all the train miles possible and reduce the cost per train mile." The transportation man of today realizes that train loading is the "yard stick" by which his efficiency is measured, and naturally finds himself continually confronted with the question, "What means can I employ to increase the trainload?"

The fundamental principle underlying train loading is to secure the maximum ton miles with the minimum train and engine miles. The following suggestions are offered as to the methods by which this may be accomplished. The conclusions are derived from experience, and are applicable to any superintendent's district, no consideration being given to the type of locomotive most desirable for any particular line, matters of grade revision, change of terminals, etc.

First, the superintendent and his immediate staff should clearly understand what constitutes the equivalent in dollars and cents, of a full load on the locomotive over the entire distance it runs. The superintendent must take cognizance of the fact that he is the leader and upon him devolves the duty of teaching his staff and others over whom he has jurisdiction, how to analyze operating statistics, statements of earnings, cost, etc. Although he may possess a full knowledge and understanding of the facts reflected by the statistical data placed at his disposal, he must realize that proper results cannot be obtained by his efforts alone, and that his subordinates are incapable of intelligent cooperation and assistance until they are qualified for an intelligent study of the results of their efforts, when reduced to revenues and expenses.

There is no good reason why information as to the earnings and expenses of the road should not be placed in the hands of those to whom the management looks for results. The staff should, if possible, meet for a short time daily for the purpose of discussing the previous day's performance. When daily conference is impracticable, the men should meet weekly and carefully review operations for the week, studying each item of expense. Trainmasters, road foremen of engines, master mechanic, chief despatcher, trick despatchers, and, if convenient, general yardmasters from the important terminals, should be present at these conferences. After two hours uninterrupted study of the previous week's performance, these men will be better qualified to handle their work during the succeeding week.

Second, an important factor in the duties of trainmasters and road foremen of engines is the enlightenment of train

and enginemen, as to the value of a maximum train in dollars and cents. Teach them that "tonnage" has an intrinsic value, and solicit from them suggestions as to how the maximum train may be handled with the minimum expense. This is a fruitful field to work, but the officer who tries it must know his subject.

Third, yardmasters must appreciate the value of train building as an aid to maximum loading. Place a few weak draft gears on the head end and cars will be set out en route, with resultant delay to traffic, extra expense in the loss of ton miles, etc., and probable damage to other equipment in the train. Yardmasters must bear in mind continually, the fact that placing the major part of the load on the rear may cause an engine to double and that short destination cars should be moved in certain trains only.

Fourth, the chief despatcher and trick despatchers are the ones who must keep the train load up and keep the train miles down. A good chief despatcher is invaluable. He can make or break a division. He must know what there is to move and what each train is moving before it has proceeded very far on its journey. Tonnage must be kept at certain points to use to fill. Agents, yardmasters and trainmen must understand just what is wanted by each train. The chief despatcher, assisted by his trick men, is the locomotive loader, and a transportation officer who does not appreciate this, has something to learn. Take the chief and trick despatchers in as equal partners. In no other way can the ton mile maximum be maintained.

Fifth, a general conference, attended by the staff, train, engine and yard men, and the principal agents should be a regular monthly affair. Consider the results with attendant costs for a definite period. Solicit their expressions regarding methods practiced and make their suggestions the subject of discussion. Keep earnings and expenses before them constantly.

Sixth, interest agents in the subject of car loading by furnishing them figures showing the results of their loading and impress upon them the importance of getting as many tons as practicable into each car. This is an important feature of train loading.

Adherence to a policy of this character will get results, because you are educating the man who spends the money and teaching him economy. In time you will overcome all obstacles in the way of maximum ton mile results.

DEPRECIATION AS APPLIED TO VALUATION

At a hearing before Commissioner Meyer of the Interstate Commerce Commission at Washington on June 18, W. B. Storey, vice-president of the Atchison, Topeka & Santa Fe, and D. F. Crawford, general manager of the Pennsylvania Lines, testified on the subject of depreciation in connection with the commission's valuation of the railroads and particularly with reference to the theory of depreciation expressed in circular 226 issued by the engineering board of the division of valuation, under which it would be impossible for a railroad ever to be new. Mr. Storey said that the life of structures and equipment is largely determined by obsolescence rather than by age and that they can be maintained indefinitely. There is no rule or data from which life tables may be constructed based on obsolescence because it varies so much in accordance with the development of the art. Retirement on account of obsolescence will probably be less of a factor in this country in the future because cars and locomotives can not be much further enlarged on account of the limits fixed by structures along the road, tunnels, station platforms, etc. He said that railroads do not often replace equipment or structures with others of a similar type because it is more economical to repair the old than to buy new. He said that the only depreciation which should be allowed for in ties or structures would be deferred or neglected maintenance and that no deduction should be made because part of the estimated service life has been exhausted, provided they were 100 per cent efficient for the service required of them.

Director Prouty of the Division of Valuation asked Mr. Storey's definition of depreciation. Mr. Storey said depreciation is decrease in value due to age and wear, but that this should be taken in reference to the railroad as a whole and not simply with reference to the individual unit. Mr. Prouty pointed out that the act provides for the ascertainment of the cost of reproduction less depreciation "of each piece of property." Mr. Storey said that this did not require calculations as to each unit of material and that if the ties in a piece of track had been in service over a number of years and had been properly maintained even if a part of the service life was gone, the track was just as efficient for the transportation of cars and locomotives over it as if it were new. Director Prouty said that apparently the principal difference of opinion was involved in the definitions. Mr. Storey said that if depreciation were to be deducted on a road under construction then a similar amount should be added to the cost of the road as an offset in order to represent its actual cost, but he did not see why any depreciation should be deducted from a railroad that is as new as it is possible to make it, as this necessarily contemplates some lapse of time after some of the materials have been put in place. He said that if a railroad were being dismantled and sold piecemeal it would be proper to deduct depreciation to ascertain the value of its materials, but in the case of a railroad not for sale its value in place should be considered.

Mr. Crawford gave similar testimony regarding locomotives, saying it is impossible to determine in advance the life of equipment except by a general law of averages which would vary widely as to individual units. He had never known a locomotive to be retired except on account of exhaustion or because it was unsuitable for the service as, for example, when all of the bridges on a division have been replaced or strengthened so that it is no longer economical to use smaller locomotives. The life of a locomotive, he said, is indeterminate and it can be maintained practically indefinitely. He did not see how the principles outlined in the circular, representing an attempt to strike a weighted average of the life of the various parts, could be practically applied. He said it was apparently contemplated that the service condition of a locomotive shall be determined by the ratio of the remaining life to the total estimated life and that he would not know how to do that with any accuracy. He maintained that the only need for a depreciation fund was to take care of obsolescence, which, he said, could be estimated more closely than the service life. He presented a memorandum which he had drawn up for a committee of the American Railway Association in 1908 to show that obsolescence is not a function of age and he presented a chart showing the varying condition of parts of a locomotive through its various cycles of renewal, which might exist, while the locomotive as a whole would be in a condition of 100 per cent efficiency as to its service. Mr. Prouty said that this demonstrated that there is an accrued deterioration in the parts of a locomotive, indicating the exhaustion of a part of the service life, to which Mr. Crawford retorted that this can be replaced out of operating expenses and he thought that there is no depreciation in a locomotive as a whole as long as it hauls its full rated tonnage.

"War Portions" in Dining Cars.—The Delaware, Lackawanna & Western now has two scales of rates in its dining cars, providing in addition to the regular sized portion of food a "war portion." War portion orders contain from one-half to two-thirds the regular quantity, and cost proportionately. It is estimated this saving will amount to $60,000 yearly.

Students of Morse Telegraphy; Learning to Send

Employment of Women in the War Emergency

A Widespread Movement; Encouraging Progress in Office-Work Schools; Quick Adaptability in Shop Work

PLANS for the employment of women in positions which usually are filled by men are already taking shape on all of the larger railroads, and apparently will keep pace with the resignations of men who are leaving their positions on account of the demands of the war; and two roads, the Baltmore & Ohio and the Erie, have already employed considerable numbers of women in shop and outdoor work. Three, the Pennsylvania, the Frisco and the Missouri, Kansas & Texas, have established schools to teach telegraphy and other station work. With the scarcity of help in different kinds of work there are interesting possibilities in the proposition to continue the employment of women, more generally than heretofore, even after the war emergency shall have been passed.

If the war continues and the number of Americans called to military service is large, the change will be extensive as well as general. Thus far, however, most of the roads are proceeding experimentally and their plans are in a preliminary or tentative state. The Baltimore & Ohio and the Erie, as above stated, have already employed a limited number of women in shops and seem to be well satisfied, so far, with the results; but most roads are content to make the change only in those employments where women already have proved well adapted and have shown a liking for the work; such as clerical work in the general offices; ticket sellers at small stations; telegraphers, stenographers; telephone operators, and car cleaners.

From inquiries made of the principal roads, it appears that the number of men who have left the service already is considerable on nearly every road; and the larger companies count them by the hundreds; but still the depletion of the regular forces (not counting unskilled laborers) is a rather small percentage, and there are no elaborate arrangements for employing women, such as are in vogue in England.

In the cleaning of passenger cars the employment of women for inside work has been common at many places in this country for years, and it is comparatively easy to extend the work to the outside operations. The main problem at present, as with men's jobs, is to find suitable candidates and to select individuals who will be most suitable and efficient.

The most comprehensive announcement calling for women in railroad service is that of the Erie, a facsimile of which is shown herewith. The original is 18 x 24 in. It will be noticed by this placard that women are to be paid the same rates per hour that are paid to men. The Pennsylvania, and other roads, have also announced that this equality of treatment would be the rule.

Schools for Beginners

The schools referred to are a logical development. For much of the railroad work which is now to be put into the hands of women, a course of preliminary training is desirable; and for some kinds it is absolutely necessary.

The Pennsylvania's school is at 1625 Filbert street, Philadelphia. It is the successor of the school which has been conducted by the Pennsylvania at Bedford, Pa., for young men, for several years past. The Bedford school is, in fact, being moved to Philadelphia, and it is now open to men and women. Under the direction of Thomas Saddington, the principal, pupils are taught telegraphy, manual block signal operation, and all station office work.

The telegraph room is 20 ft. x 40 ft. and contains two long tables, one on each side of the room fastened to the walls, which will accommodate 28 students—14 on each side. There is also another table in the center of the room, parallel with the other tables, to accommodate 12 on each side. These tables are wired in such a manner as to allow the student to enter any speed class at the request of the instructor, without the student changing his seat. These classes are made up of speeds of five, ten, 15 and 20 to 25 words a minute. This is accomplished by having four circuits around the room and a four-holed jack switch box on each table.

The train room is also 20 ft. x 40 ft. and is equipped with a miniature railroad built in the form of a "U," around which the telephone and telegraph block offices are built at intervals. High partitions separate each "station" from the stations on either side. Students practice with both telegraph and telephone block signaling.

The course of study requires from six to eight months for completion. If the demand for help at stations becomes

urgent, it will be necessary, of course, for some of the agents to utilize untrained or half trained assistants, who, by hook or by crook, will learn as they go along, will "learn by doing" so far as that is practicable. The normal procedure, however, whether in war times or ordinary times, is to train every novice as thoroughly as practicable. In the Philadelphia school there are two instructors; and the pupils at present number 30 men and 12 women.

The rule which has been in effect from the first, that students completing the course in a satisfactory manner shall be assured steady employment on the railroad, is continued in force. This implies, of course, that if those who are given positions are faithful in the discharge of their duties they will be in line for promotion to higher positions.

Erie Railroad Company

WOMEN NEEDED In Railroad Work

MANY WOMEN are needed to fill the places on the ERIE RAILROAD that will be made vacant by the call of MEN to MILITARY OR OTHER WAR SERVICE. THE RAILROADS must render FULL EFFICIENCY during the WAR PERIOD in order to meet the REQUIREMENTS of the NATION. ALL POSITIONS must be kept FILLED if such service is to be rendered.

Women can find few more important ways to show patriotism at such a time than by offering their services for the many positions of suitable work on railroads that have heretofore been filled by men. POSITIONS paying high wages are and will be open for EXPERIENCED BOOKKEEPERS and ACCOUNTANTS. POSITIONS are available for women that have FAIR EDUCATION but who are WITHOUT EXPERIENCE. Many other positions are available for WOMEN in GOOD HEALTH, along the lines of ORDINARY LIGHT LABOR.

In order that the ERIE RAILROAD may fulfill its duties to LOCAL COMMUNITIES and to the NATION IN GENERAL, WOMEN who are willing to accept any position as indicated above are requested to CONSULT THE LOCAL AGENT and REGISTER for such work as they are ready and fitted to undertake, either in the community where they reside or at other points.

No distinction will be made in rates paid as between men and women performing the same work.

Erie Railroad Company

The qualifications, which are the same for both men and women, are: Age, over 17 and not over 30; good eyesight and hearing; good health; and a fair knowledge of English, mathematics and geography. Students who have proved unsuitable have always been advised in time so that they have not wasted their energies in unprofitable study.

Classes are held daily except Saturday, Sunday and holidays from 9 a. m. to 4 p. m., and evening classes are held on Monday, Wednesday and Friday from 7 to 10.

Graduates remaining in the service of the Pennsylvania Railroad for a period of six months, rendering satisfactory service, are reimbursed by the company for the small entrance and tuition fees paid to the school while learning.

There is at Philadelphia an independent school which gives preliminary instruction to girls in traffic matters and other station subjects. This school is noticed in our news columns.

The Missouri, Kansas & Texas has opened four schools, on a general plan similar to that of the Pennsylvania school. They are at Parsons, Kan.; Muskogee, Okla.; Denison, Tex., and Dallas, Tex.

At Dallas, which is the headquarters of the general manager, the school already has 36 pupils, which is its capacity at present. It is in charge of an experienced telegraph and telephone operator. The company's other three schools have about 20 students each. The students thus far have been drawn from residents near by, but applications have been received from women and girls throughout a wide territory. The schools, thus far, are somewhat experimental and no definite length of course has been decided upon; but there is evidently no lack of pupils. There are grounds to believe that, with the telephone, bright girls can be educated to handle train orders in perhaps eight weeks; but all students are required to take instruction in Morse telegraph as well as the use of the telephone, and those who qualify for work with the telephone will have a rudimentary training on which to continue the study of telegraphy after they have taken a position.

Each student receives instruction for ten or fifteen hours a week in other station work, such as making reports and selling tickets. Pupils are accepted at ages from 18 to 32, and there is no charge for tuition. Each student merely puts herself under moral obligation to take service with the road when qualified. If a pupil leaves a school before finishing the course, a nominal sum is charged for tuition. The officers of the road are well pleased with the experiment thus far; and if their expectations are realized, the educational activities will be largely extended.

At Mount Clare Shops, Baltimore & Ohio

The St. Louis-San Francisco school is at Springfield, Mo. It was opened in May and already has 56 pupils, and good progress is being made. This school teaches only telephone and telegraph work and it is expected that the pupils will continue throughout a course of about six months. No tuition is charged. The instructors are experienced railroad men, and

the company intends to carry on the work as thoroughly and as extensively as may be found practicable, with a view to avoiding, so far as feasible, the teaching of novices in the station offices, while yet taking all reasonable measures to maintain high standards in this department of the work.

Skilled and Unskilled Work at Shops

A report of T. S. Davey, superintendent of the car shops of the Erie Railroad at Buffalo, N. Y., expresses decided satisfaction with women's work. He has had a number of them in his employ for a month. He says:

"We have one woman running a bolt cutter. She is working 100 per cent piece-work and is doing as well as the boys running the other machines, who also work 100 per cent piece-work. The ages of these boys range from 16 to 18 years. We have one woman building grain doors from old siding removed from box cars. She does very well; has been at it about one week and is building from 22 to 28 doors a day. The men previously doing this work, who were accustomed to it, made from 35 to 40 doors daily. In a short time this woman will undoubtedly be almost equal to a man at this class of work.

"The women sweeping out the shop buildings—paint shop, planing mill and other repair shops—are doing as well as the men used to do; and in regard to cleanliness the

Courtesy Buffalo Evening News

At the Erie Shops, Buffalo

shops are kept cleaner. Of course, there are some pieces of heavy material which they cannot handle. Women cleaning the yards are doing just as well as the men did, though here, as in cleaning shops, they cannot handle heavy pieces of lumber. They can load and unload light lumber just as well as the men. They pick up old scrap wood around yards and load into cars, just like men.

"We have two women working in the store department. They are giving out bolts, nuts, washers and cotters, nails, etc. Previous to putting these women in this department, two men were doing the work. As far as we can see, the two women will do it just as well as the two men; and we have received no complaint from the employees who are waited on by these women. We are just beginning the employment of women in other departments of the storehouse, and there appears to be no reason why they will not be able to fill the bill.

"We have five women in the office and for the time they have been working at this class of work, they are doing very well. The novelty of having women employed in shops and yards seems to have worn off and men pay no special attention to the women. During the first few days of this ex-

On the Baltimore & Ohio

periment, one man was taken out of the service for trying to annoy women."

The employment of women in the shops of the Baltimore & Ohio will be recalled by the reader from recent illustrated news items in the *Railway Age Gazette.* This road now has women in about 20 different shops, and there are from five to 35 women at each shop. They work at cleaning up the shops and yards; loading light scrap; packing journal boxes, cleaning windows and serving as janitors. They are also employed at some regular machine work; running bolt cutters, pipe threading machines and nut tappers; and they operate steam hammers. They reclaim waste, wash windows, clean the interior and exterior of passenger cars, and clean castings. In short, their services are being utilized in all kinds of light work, and the foremen report the results as satisfactory. The women generally seem to like the work. The company provides suitable rest rooms."

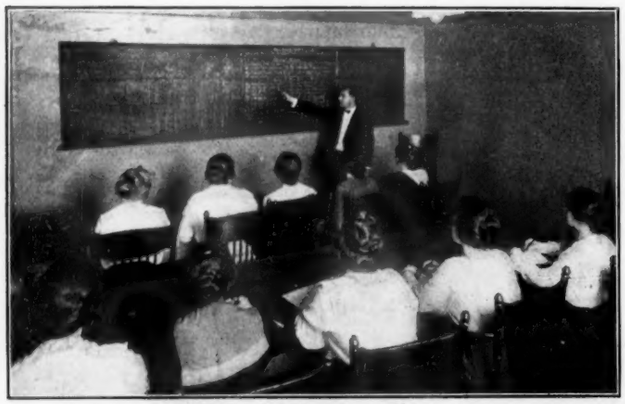
English Experience

The employment of women in outdoor and shop work on the railways of England has already been made familiar to readers of the *Railway Age Gazette.* A recent estimate places the number of females employed in all industrial occupations incident to war work, in England, at one million, over half of which number is assigned to munitions and direct war occupations. In this million are included 100,000 workers in "transportation" which, no doubt, takes in omnibus conductors, and may include other classes not coming under the head of railroad work proper. To what extent this total is inconsistent with the estimate of 41,000 quoted below, there is no means of knowing. In France the proportion of women workers is said to be less. In England, with over 400,000 women and girls employed in munition factories, strong trade unions of women have been formed.

As to the numbers employed in different departments of English railways the figures are rather indefinite. A recent statement concerning the Midland Railway gave the total on the road as 6,300, or 5,000 more than before the war; but the 5,000 were "mostly engaged on munitions, under the chief mechanical engineer." The 1,300 females employed on the South Eastern & Chatham were classed as clerks 581; porters

350; carriage cleaners 160; miscellaneous 209. Officers of the railways are quoted in high praise of the devotion of the women and the quality of their work.

One of the principal lessons learned in the employment of thousands of women in shops and factories in England, is that care should be taken to avoid overwork; to maintain



Pennsylvania R. R. School—Instruction in Proper Wording of Messages and Train Orders; Also in Other Station Work

the rest periods which are customary in times of peace. This is the conclusion reached by a special committee appointed by the ministry of munitions in September, 1915, the report of which committee has been published by the United States Bureau of Labor and entitled "Bulletin No. 233; Women In Industry Series No. 11." This British report holds that long hours are decidedly objectionable, especially when worked during the night; that there should be suitable pauses for rest during the work period, and that there should be adequate weekly rest. A portion of Saturday and all of Sunday should be available for rest. The periodic factory holiday should not on any account be omitted. Women employed in unusual work should be examined by a medical woman so as to prevent minor ailments and detect incipient or actual disease. The report deals also with the employment of juveniles. It appears that children had worked voluntarily on Saturday afternoons; but after a time, it is said, the requests for permission to do this became less frequent. Boys and girls under sixteen should not work over 60 hours a week; and the three-shift system is better. It was found, however, that many of the children workers had suffered from curtailment of sleep. It is believed important to provide systematic means for instructing children in the best methods of performing their work and also to stimulate their interest and relieve monotony.

To insure the welfare of boys—the welfare supervision of girls seems to have been well attended to—the ministry of munitions has recommended that attention be given to the following points:

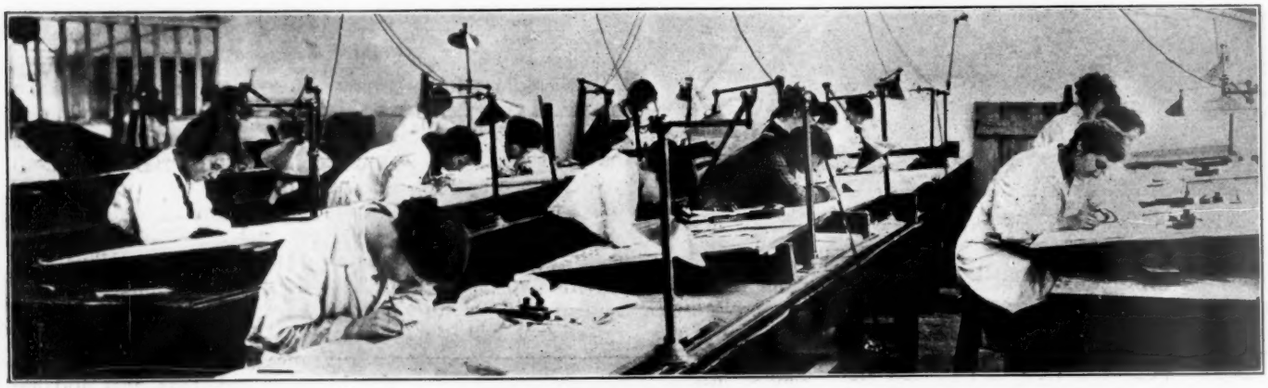
1. To become acquainted with all boys when first employed, to be present at the medical examination by the factory surgeon, to note any matters needing attention, to arrange for the re-examination of special cases.
2. To visit cases of sickness and to investigate other causes of irregular attendance and of complaints in regard to the work.
3. To receive complaints made by boys and their parents and to dispose of misunderstandings.
4. To be consulted before any boy is dismissed.
5. To watch the conditions of housing and transit and the facilities for obtaining food.
6. To supervise and promote arrangements for saving.

Instruction in Signal Indications—Pennsylvania R. R. School

7. To seek facilities for recreation and to organize their use.

The report contains an estimate of the total number of women employed in transport service, in substitution for males on April 1, 1916,—it was 18,000. The number of women thus employed in transport service, not including municipal, on October 1, 1916, in the whole of Great Britain, was estimated at 41,000.

In the metal trades it appears that women work on night shifts from 12 to 12½ hours with two intervals for meals of from 30 to 45 minutes each. Women working in the daytime usually are on duty 9¾ hours, with two intermissions



An English Drafting Room

for meals, one of 45 minutes and the other of 60 minutes. These are the same work days as those which are worked by the men.

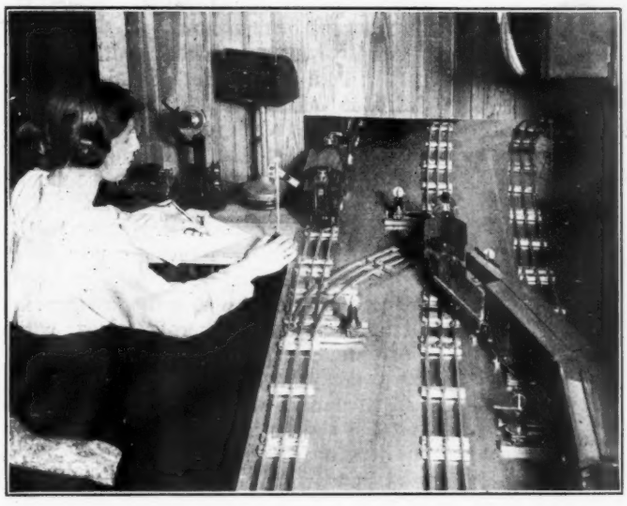
The women engaged in the metal trades have organized in trade unions to the number of 3,000 or 4,000. This is estimated to be about one-fifth or one-sixth of all the women employed in these trades.

In Scotland the railways employ about twice as many women as before the war. They work as ticket collectors, ticket sellers, carriage cleaners and porters.

The employment of women at the highest rate of efficiency involves elaborate plans and studies, as well as effective co-operation. One English report says:

"The great question that has confronted us throughout and which has been the cause of anxious negotiation between the government, employers, trades unionists and the representatives of women's trades unions has been that of substitution. There are four forms of substitution:

"First—Direct substitution of one woman for one man. This is not very frequent in the case of skilled workers, though lately there has been a large number of direct replacements.



Pennsylvania R. R. School—Admitting a Westbound Freight to the Middle Siding. Eastbound Electric Passenger Train on South Track

"Second—Indirect substitution, where a woman or girl takes the place of an unskilled or partially skilled man, or occasionally of a youth, and thus sets free an unskilled or partially skilled worker to take the place of a fully skilled man.

"Third—Group substitution, where a group of women takes the place of a smaller group of men, doing the same work but giving a smaller output per worker.

"Fourth—Substitution by re-arrangement, when women with the help of improved or automatic machinery may take over work previously requiring the attention of fully skilled workers, or by a rearrangement of the work a group of women workers with the supervision of one skilled worker do a job previously done by skilled workers.

"There are still over a million women who have commercial or industrial experience who might be used to take the place of men; but the majority of these are over thirty-five and have homes and children."

Among the more important lessons noted in the conclusions of English investigators are that in employing large numbers of women cleanliness of surroundings, provision of rest rooms and dining rooms and the supplying of proper meals, are of the first importance; and "most important of all, see that women are fairly paid for their labors and not worked so hard as to render them overstrained, with the possibilities of serious injury to the future of the race."

This last admonition is put forth in connection with an examination of conditions in munition factories, food preparation and other industries where the spirit of patriotism has produced over-enthusiasm, leading many women employed in these industries to exert themselves beyond reasonable limits.

DISORGANIZATION OF MECHANICAL FORCES THREATENED

The Railroads' War Board has asked the Council of National Defense to define the government policy with regard to the enlistment of machinists or other skilled railway employees, to avoid as far as possible any depletion of the forces, which would interfere with the efficient operation of the roads. In view of the experience of the British roads it would seem that this question should receive consideration at this time. In England the roads have released about 25 per cent of the normal force of employees, and it has become necessary to class railway mechanics as exempt from military service. There is no question as to the patriotism of American railroad men, but many may be able to serve their country better by remaining at their posts than they can by enlisting.

At the present time there is danger of mechanics being drawn away from the shops in such numbers as seriously to impair the efficiency of the railroad systems. It is generally conceded that the transportation lines of this country will have to take care of heavier traffic than they ever have had before and that it is of great importance that they should meet the demands made upon them in the best manner possible. To do this will require an ample supply of locomotives, and since the number which are being exported will reduce to a considerable degree the new motive power which the railroads in this country can secure, all existing power must be kept in efficient condition. For this reason the railroad shops must be worked at their full capacity and if this is to be done a full complement of mechanics is necessary.

Railroad mechanical officers, realizing the task before them, are viewing with alarm the large numbers of their younger men leaving the mechanical department. Many men have already been recruited in the railroad regiments and there is a prospect that more will be drafted for active service. At the present time the navy yards are drawing a great many mechanics from railroad shops. The campaign to secure mechanics for ship-building caused such a serious shortage of men on one road that the government was requested to withdraw the advertising matter which had been distributed along the line. The railroad's request was promptly complied with.

The men who are leaving the railroads and entering the government service other than the Navy and Army now are not moved by patriotic impulses, but in many cases are taking this means of escaping the liability of active military service. The railroads will find it very difficult to replace them, as mechanics who have been trained in other industries cannot as a rule be used successfully on railroad work. The navy yards could no doubt use mechanics drawn from other sources where their positions might be filled by women. For this reason the recruiting of mechanics for the navy yards from the railroads should be discouraged.

The reorganization of the industries of the country to meet the demands of war must proceed slowly. If more mechanics are taken from them at the present time the railroads in this country may find themselves in the same position as those in Great Britain, where the shortage of men seriously hampered the operation of the roads.

The Military Aspect of Railroad Preparedness*

Close Co-operation Between Railroads and Government Necessary Successfully to Carry on the War Operations

By B. F. Cheatham
Lieut. Colonel, Q. M. Corps, U. S. Army

THIS subject is one of immense importance, and on the proper solution of it by the government and the railroads depends, to a great extent, the well-being of our country. Unfortunately in our discussion we are limited to the expression of individual opinion for the reason that there is practically no literature on this particular phase of the question and whatever the war department may have done recently is not available to the public just now.

It has been suggested that it would be desirable to outline to you the part to be played by each railroad department, and each railroad employee in time of war; this would seem to pre-suppose that all railroads would be placed under military control at the outbreak of a serious war, and while not in the confidence of the war department on this subject I do not believe such action is either contemplated or desirable.

Lieut. Col. B. F. Cheatham

Co-operation between the department and the railroads is what is wanted; without it there must be confusion no matter what general system is adopted, and with it any system will get good results; it should be the whole-hearted desire of every railroad, and each employee thereof, to give to the transportation of troops and supplies the very best effort made possible by years of experience; on the other hand the government should earnestly endeavor to arrange the public demands on the transportation lines so as to interfere as little as possible with the normal business of the country. The only two contingencies which might require the war department to take over the operation of the railroads, or a part of them, would be in case of invasion of the country by the enemy, or the failure of the roads to render the service demanded; fortunately there is small prospect of either of these coming about.

It is well to understand the distinction between the operation of railroads for military purposes, and the construction, operation and maintenance of military railroads. In the first case the existing commercial roads are simply called on with their existing personnel temporarily to perform the duty of transporting men and supplies under governmental direction to meet an existing emergency. The second case is entirely different; a military railroad is one built or taken over by the army for purely military purposes; it generally follows the advance, is hastily constructed and is maintained and operated under the direction of the commander of the line of communications; the first is the one we are particularly interested in and will be given first consideration.

In the present phase of the war into which we are just entering there is no prospect of any emergency justifying the operation of the roads of the country on a purely military basis. The roads, therefore, should be operated by their own officers and in accordance with good practice, except that they must adjust their business so as to give military traffic precedence over purely commercial business.

The authority for giving precedence to government business is contained in U. S. Statutes as follows:

"In time of war, or threatened war; preference and precedence shall, upon the demand of the President of the United States, be given, over all other traffic, to the transportation of troops and material of war, and carriers shall adopt every means within their control to facilitate and expedite the military traffic."

It is hardly to be expected that it will be necessary for the government to invoke the aid of this law, but it is some comfort to know it is in existence ready for use in case some unforeseen emergency renders its operation imperative for the good of the country.

As an evidence of good faith on the part of both government officials and the railroads in the mutual desire to bring about good service your attention is invited to the fact that all during the period of great activity incident to the mobilization of troops on the Mexican border there was a committee of eminent railroad men actually located in the war department working in connection with the officers in charge of transportation in the quartermaster general's office, with the result that probably never before in this country have so many troops moved such distances with so little friction—and it is certain in this war that such an advisory board of specially selected railroad men will be put on duty not only in Washington, but at each department headquarters, where all matters effecting rail transportation may be co-ordinated by experts before orders effecting large movements of troops are issued. At present a representative of the American Railway Association is assignd to duty at each camp in the Western Department to co-operate with the quartermaster and to assist in compiling data covering transportation facilities.

Our country seems to have finally awakened to the necessity of preparedness, real preparedness, to include all branches of the subject, and the public press is full of the action being taken by the many organizations which exist for the purpose of furthering the general interest. Of these branches, probably our railroads are among the most important, but at the same time are more nearly prepared now than any of the others; this is not surprising when you consider that a very rigid discipline is exacted, that efficiency is the concerted aim of all, and that the incompetents are eliminated either by discharge or pension, to the end that the men who fill the important places in the railroad world are almost without exception self-made, in the sense that they must have made good in the lower places before being placed in positions of trust and responsibility. These men know their business and consequently get results. The work is divided into departments, each properly co-ordinated and in charge of an expert; therefore it would require a grave situation to justify the transfer of this vast business with its multitudinous ramifications, to a temporary control by the army during war.

* From a paper presented to the Pacific Railway Club San Francisco, on April 12, 1917.

What is said here primarily applies to the physical operation of the roads. It must be understood that the policy governing the movement of men and supplies must be vested in the war department, and that orders concerning the movements of troops and supplies remain with the army. The responsibility of getting results remains with the roads.

The railway business in war is roughly divided into two classes, first, the handling of troop trains, which are sent under agreed schedule to certain points of concentration or mobilization; second, the shipment of military supplies to depots or to mobilization points. The danger is that these shipments may be delayed unduly and the efficiency of the roads will be measured by the speed with which these movements are made, and one of the difficulties will be the prompt unloading and speedy return of the empties.

As you are probably aware, there have been certain differences between the several railway associations and the war department in the past, but much has been done during the past two or three years to harmonize these differences. For instance, the government has accepted the uniform bill of lading as prepared by the railroads. One of the important things which the quartermaster corps has attempted to bring about is a definite classification of the impedimenta which, to include animals and vehicles, must accompany troops in unit shipment. Some progress has been made, but at least two of the railway associations have failed to agree to the views of the government and the matter is still in abeyance, much to the detriment of the railroads, as many accounts are held up by the auditor for the war department.

Preparation in Time of Peace for War.

The fact that railway organization is based on peace time conditions, for the purpose of commercial operations, and frequently to meet active competition, makes it manifest to the most casual observer that no matter how efficient the roads are for transaction of their present business there must be certain important preparations and plans made in time of peace promptly to meet war conditions. These depend on whether the roads are to continue under their own management, or be taken over by the war department.

No matter what the plan of campaign or the location of the enemy the first shock so far as the railway service is concerned is the mobilization. If that can be effected without disrupting the regular business to the extent of seriously disturbing business conditions, the rest can be worked out.

Probably the most important preparation to be made from the organization standpoint is the perfection of some sort of efficient control by properly constituted and responsible intermediaries to stand between the over-zealous military man without practical railroad experience on the one hand, and the equally zealous railroad representative without any knowledge of military requirements on the other. It is, however, reasonable to assume that a safe working plan has been agreed upon and that the great confusion in transportation which marked the early days in the Spanish-American war will be avoided in our next experience.

Other preparations which may be mentioned as properly coming under the controlling body are:

(*a*) Preparation of military schedules, or time tables, based on the speed of mixed trains to carry troops, animals and supplies. This has been undertaken by the office of the quartermaster general, and schedules are on file showing routing from each army post, and probable mobilization point in the United States to the concentration points and between the latter and important ports on the eastern, western and southern coasts; these cards show junction points, total distances and approximate time required.

(*b*) Proper system of marking cars readily to determine contents and avoid confusion in obtaining the stores required. This has already been accomplished by an arrangement agreeable to the Railway Master Mechanics' Association, which provides for certain placard markings on the cars which indicate that the stores contained in such cars not only belong to a certain department, but show character of contents and practically give the information contained in the bill of lading. The color of these placards will show the department to which the property pertains and should assist materially in expediting the delivery.

(*c*) A well-regulated system of forwarding military supplies in order both to avoid congestion at stations and junction points and to insure prompt arrival of supplies in the right quantities, at the right place, and at the right time.

(*d*) The development of special gangs and the collection of proper material for the prompt installation of additional side tracks and switches. The sites selected for mobilization camps should theoretically be provided with ample storage and side track facilities, but actually this is seldom possible. Therefore, it is of prime importance that the roads be provided with material for additional side tracks and switches, also of loading and unloading platforms.

(*e*) The collection and tabulation of data covering the resources of all roads, grades, facilities for loading and unloading, etc. This data may be kept up-to-date by each road since it is manifestly essential to the proper conduct of the business, but each road should have this information concerning the facilities of all other roads in order that mutual exchange of appliances may be made, since it is conceivable that the rolling stock of one road may be overtaxed on account of army work while another may have no extra traffic, its surplus equipment being available to help out the other.

Another highly practical preparation for war in time of peace which has been extensively practiced in Europe is the construction of special strategical lines expressly designed to facilitate the mobilization of troops, their speedy concentration at certain selected points, or their movement from one point of attack to another. We have done practically nothing in this respect; our roads are primarily located for commercial purposes unless we except the first trans-continental lines which were built with government assistance.

From data compiled about a year ago the entire resources of the combined roads of the United States as to rolling stock consisted of 63,000 locomotives, 59,000 passenger and 2,421,000 freight cars. To move a field army of about 83,000 men, including animals and equipment for the field would require seven-tenths of one per cent of the locomotives, four and two-tenths per cent of the passenger equipment and two-tenths of one per cent of the freight cars.

To move an infantry division of approximately 22,000 men, 7,500 animals and 900 vehicles, would require 533 coaches, 45 baggage, 245 box, 383 stock and 301 flat cars, a total of 1,507 cars of all kinds, besides 75 locomotives. This equipment occupies 15.5 miles of track.

In the movement of troops by organization it is most desirable to avoid as far as practicable the breaking of the military units. This is to include animals, vehicles and equipment. The length of a train section, of course, depends on local conditions concerning grades, curves, etc., but generally speaking 20 to 24 cars should constitute a section. Ordinarily this will carry the following at war strength:

1 battalion of infantry, or
2 troops of cavalry, or
1 battery of field artillery, or
1 company of engineers with bridge train.

An infantry battalion at war strength contains the following personnel and requires the following train equipment:

13 officers	1	standard sleeper
566 enlisted men	12	tourist sleepers
6 horses }	1	stock car
12 mules }		
3 wagons	1	flat car
About 120,000 pounds of baggage	2	baggage cars
Rations, forage and equipment	5	box cars
Total	22	cars

In case the standard and tourist sleepers are not available, and the need is urgent, officers and men would be loaded into whatever equipment was on hand.

While not entirely pertinent it may be of interest briefly

to outline the experience and organization effected for purposes of railroad transportation by the Federal Government during the Civil War, but before doing so it may be safely stated that the conditions were such that without the aid of railroads it could hardly have been fought at all. The area of the operations was equal to the whole of Europe, vast sections were practically devoid of wagon roads, and in many cases it was necessary to bring food supplies from distant points. The railroads were mostly single track, poorly constructed, with poor ballast and light iron rails.

On account not only of the difficulty of operations, but of the great problems of protecting the railroads the federal government early recognized that some form of central control was required. In March, 1861, it took possession of the Philadelphia, Wilmington & Baltimore Railway and shortly thereafter Congress passed a law authorizing the President to take possession of railway and telegraph lines. Among other things this act provided "That the transportation of troops, munitions of war, equipments, military property and stores, throughout the United States, should all be under the immediate control and supervision of the Secretary of War, and such agents as he might appoint."

Under this authority and of date February 11, 1862, the Secretary of War issued an order to the effect that Daniel Craig McCallum, then general superintendent of the Erie Railroad, "be, and he is hereby, appointed Military Director and Superintendent of Railroads in the United States, with authority to enter upon, take possession of, hold and use all railroads, engines, cars, locomotives, equipments, appendages and appurtenances that may be required for the transport of troops, armies, ammunition and military supplies of the United States, and to do and perform all acts and things that may be necessary and proper to be done for the safe and speedy transport aforesaid." This shows how serious the situation had become and how necessary it was to have one man control. One of the great difficulties was the difference in track gage of the various companies. There were in existence at that time gages of 6 ft.; 5 ft. 6 in.; 5 ft. 4 in.; 4 ft. 10 in.; 4 ft. 9 in. and 4 ft. 8½ in.

Another serious difficulty was the habit of the Confederates of blowing up bridges and destroying long sections of track; all of this necessitating the relaying of a vast amount of track and the re-construction of bridges, and road bed. It soon became apparent that the work must be divided, so two distinct departments were created under McCallum, the transportation department, and the construction corps. This arrangement was developed into a most effective organization and the feats accomplished by the construction corps sound little less than marvelous.

These innovations in modern warfare by the United States, in the organization on a comprehensive scale of a construction corps for the combined purposes of repairing, destroying and operating railways, attracted great attention in Europe, particularly in Germany, which was the first country to follow the American lead.

The conditions affecting railway operation during the Civil War, and those existing at the time of the Spanish War were so radically different as to preclude a comparison; but some of the cardinal principles evolved from our former experiences were lost sight of in the early days of 1898. General criticism does not profit us but it is apparent at this distance that the mistakes and failures of those days were pretty evenly divided between the war department and the railroads, and the co-operation that I so strongly insist on was conspicuous by its absence. In many instances camps and mobilization points were chosen on account of political pressure usually backed by a particular railroad, regardless of the fact, (or maybe because of the fact) that it was reached by a single line of road, was without adequate sidings and generally had no military value. Conspicuous among our troubles was Port Tampa. Troops and supplies were piled into the town of Tampa by all the roads of the country converging on that point, and from there it was expected to handle them over the nine-mile terminal track to the embarkation point at Port Tampa. I wonder if your imagination can picture the result. They tell a story to the effect that in a very important shipment of supplies it was decided to send a special train from Philadelphia in charge of a representative of the quartermaster department with orders to go through on express time and the quartermaster was advised of its coming. After three weeks' search by the entire force the train was finally located in a siding 18 miles from Tampa. There is no record of what became of the special agent.

Military Railroads

Military railroads proper may be divided into two groups: First, field or siege railroads, constructed in the theater of war for moving heavy guns to their position, conveying ammunition and heavy supplies to siege batteries, or magazines, bringing up re-inforcements rapidly, conveying working parties to and from their work, removing sick and wounded to the rear and other similar purposes. The cars may be hauled by animals, gasoline motor or by men.

Second, "supply" railways specially constructed to convey troops and supplies from the base to the front in time of war. Such roads differ from the commercial road in that (*a*) they are of a temporary character hastily constructed of whatever material is available; (*b*) they are constructed and operated by the military personnel; (*c*) they usually follow the army and therefore may not have the best location and admit of grades and curves not permissible in first-class construction; (*d*) the speed is less than usually required for commercial work; (*e*) a military road is operated on the presumption that the track is unsafe, just the opposite from the theory of civil roads.

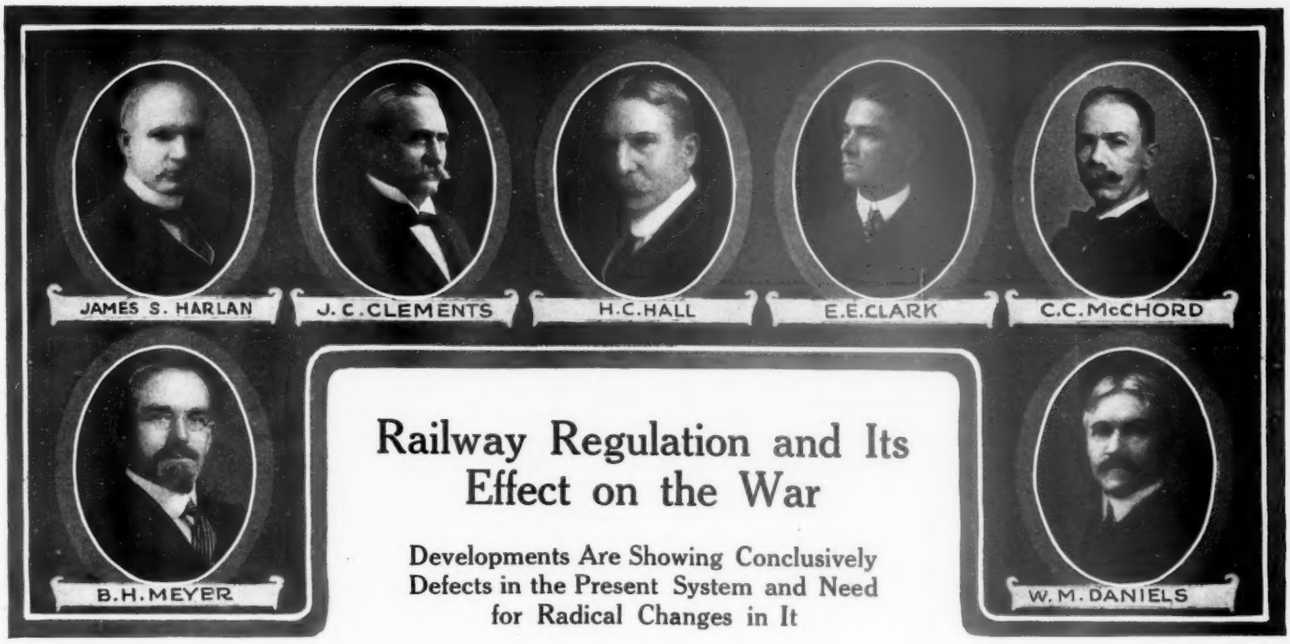
The earliest instance of a purely military railroad being constructed to serve the purposes of a campaign, occurred during the Crimean War. It was between the camp of the allies at Sebastopol and their base at Balaklava, a distance of about eight miles. This line today would be considered a joke, but it was considered wonderful then and was certainly the beginning of a development which has made war on a large scale possible.

Preparation in time of peace also differs from the commercial. The entire personnel must be hastily gotten together and large quantities of construction material of all kinds must be found. For meeting both of these deficiencies we must look largely to the railroads. It must be remembered that we will not only have to build a road but will have to defend it, and rebuild it promptly in case a part of it is destroyed by the enemy, and it may be that we also will have to be equipped to promptly and effectively destroy it ourselves. For these purposes a highly trained construction and destruction corps is imperative and this is the place for certain elements of our civilian specialists who would come in under military organization.

Such an organization must be permanently assigned to that work and have completely equipped construction trains fitted up for sleeping and eating as well as work trains with all tools, appliances and material ready to go on short notice.

The traffic organization of a military railroad is somewhat similar to a civil road. Freight is received and deposited in the usual way. It is forwarded in the order of receipt except where special preference is to be given to a particular shipment, the priority being determined by an officer with special authority to determine such things.

I know there are many young men here tonight who want to do something themselves. To all such I would personally say that unless you occupy a very subordinate and non-technical place, and have not the military experience required to make you a useful instructor, the best thing that you can do to serve your country in this emergency is to stick by the railroad and render to the government, through it, your very best effort where you have been trained.



Railway Regulation and Its Effect on the War

Developments Are Showing Conclusively Defects in the Present System and Need for Radical Changes in It

THE most serious question affecting transportation now confronting the country is as to whether the railways will be able to handle the traffic which will be offered to them during the continuance of the war.

The existing car shortage has lasted longer than any previous one. It is larger than any previous one. Unlike all earlier ones, instead of declining or entirely disappearing in the late winter or early spring, it had constantly grown larger up to May 1.

To those who have studied the relationship of railway facilities to traffic over a period of years, these are facts of great and ominous significance. They indicate that even if no large movement of military traffic were imminent, the country would find its industry and commerce crippled next fall and winter by the largest car shortage, and most severe congestion of traffic ever experienced. But a large movement of military traffic, in addition to an unprecedented movement of commercial traffic, is imminent. In England the war has increased railroad traffic 50 per cent. On some railways in France it has doubled it.

How are the railways going to be enabled to solve the problem which will be presented by the situation which will develop next fall and winter, and which is perhaps destined to continue to exist as long as the war lasts? They can solve it only by utilizing to the utmost all the facilities they have and with which they can be provided; and they can get out of the facilities already existing the greatest possible service, and make the greatest possible additions to the existing facilities only if they receive the unstinted co-operation and support of the National and State railway regulating authorities.

Regulation May Hinder Or Help

RAILWAYS should be granted rates necessary to provide additional facilities.

It is vital that the roads be well maintained and earnings should be sufficient for this.

The valuation of railways should be discontinued.

Legislation should be enacted to prevent strikes.

Regulating authorities should not hinder changes in service needed to increase transportation capacity.

In the past the regulating authorities have devoted most of their energies to holding down or reducing rates, to securing minor improvements in service and to helping labor obtain advantages at the expense of the railway companies. The fact cannot be too strongly emphasized that for the present these things, from the standpoint of the nation, have become of little consequence and that the imperative need at this time is for conserving, utilizing and increasing to the utmost extent practicable the capacity of the railways for handling traffic, and specially freight traffic. The railways must move expeditiously and safely a much larger business than ever before if they are to play well their part in the war; and if they do not play well their part, the economic welfare and military operations of the nation will be imperiled. Any of the regulating authorities that do not recognize this fact and act accordingly will assume a responsibility for the results not only of railway operations, but of economic developments and the conduct of the war, which intelligent and patriotic public officials will not lightly assume.

In what ways can the regulating authorities help the railway managements to make the transportation system per-

Commissioner Clements died Monday after the cut at the head of this article had been made.

form efficiently its part in the war? They can help them by permitting the roads to earn such sums as will be needed to maintain the properties in good operating condition and to provide imperatively needed additional facilities; by refraining from imposing or enforcing requirements or restrictions which will tend to divert money and labor from purposes which are of vital importance to those which are of less moment; and by actively co-operating with them in their efforts to get the maximum service out of every track, yard, car and locomotive.

In recent years the main object of most regulation, especially that of the States, has been to prevent the railways from earning more than the regulating authorities have regarded as a "fair return." Even before war came, developments demonstrated the unwisdom of this policy. The main object of regulation, in so far as it relates to earnings, should be to cause the railways to earn no less, and at the same time no more, than is sufficient to enable them to raise enough capital to develop their facilities adequately to handle the country's commerce; and it is chiefly owing to the fact that regulation has disregarded the latter standard, and has attempted to apply the so-called "fair return" standard that the country is to-day confronted with the greatest shortage of transportation facilities ever known. This shortage of facilities would be a serious enough matter if we were at peace and might confidently expect to continue so. The fact that it has developed simultaneously with our entrance into the greatest conflict in history makes it a far more serious matter, and may even make it a calamitous one.

Since the kind of regulation of railway earnings we have had is mainly responsible for present conditions in the transportation field, it is obvious that a continuance of it will aggravate these conditions, while a radical change in it will at least tend to prevent them from getting worse.

If it were practicable for the railways largely to increase their facilities at the present time it would be highly desirable for them to do so. Present indications are that no matter how efficiently they may conserve and utilize their existing facilities, they will continue to prove inadequate to the demands upon them. But it is evident that during the war the absolute increases which can be made in facilities will be relatively small, and that reliance for the furnishing of an adequate supply of transportation must be placed mainly upon the most effective possible maintenance and use of those existing. The regulating authorities can either help or hinder the railways both in making the largest possible increases in facilities and in securing the maximum conservation and utilization of those already existing.

Increased Net Earnings Are Imperative

It is quite evident that without larger net earnings than they have had within recent years, excepting in 1916, the railways cannot possibly make any substantial increases in their facilities. Additions and betterments may be made directly from net operating income, or from new capital on which net operating income is used to pay a return. On any new securities issued a higher return will have to be paid than it has been necessary to pay in the past on similar securities for several reasons. One of the principal of these is the enormous increase in the demand upon the world's capital caused by the war. Since with their present net operating income the railways, on the whole, are unable to pay an attractive return on their present investment it is evident that without a substantial increase in their net operating income they could not pay a still higher return upon any substantial additional amount of capital.

Another point of very great importance is that owing to the great increases which have occurred in railway wages and in the prices of all kinds of equipment and supplies a given amount of new capital or of net operating income will not provide nearly so large an addition to facilities as it would have a few years ago. This point was made very clear by some figures which R. H. Aishton, president of the Chicago & North Western, recently presented to the Interstate Commerce Commission in testifying in the 15 per cent rate case. He showed that on the average during the last ten years the North Western road has spent $6,358,000 a year for equipment. The average amount of equipment it has got for this sum has been 4,281 freight cars, 94 passenger cars and 94 locomotives. In 1917, however, for an expenditure of $6,444,383, it has been able to get only 2,000 50-ton gondolas and 50 locomotives—that is, for practically the same sum it has got less than half as many freight cars, but a little more than half as many locomotives and no passenger cars at all.

In other words, as a means of acquiring additional facilities, a dollar of net operating income is worth only one-half as much to a railroad now as it was two years ago. Therefore, if the public authorities should so regulate the railways that after paying a return upon the present investment in their properties they would have only as much net operating income left with which to provide additional facilities as they have had on the average during the last ten years, they would be able with this money to provide only one-half the additional facilities which they have been able to provide with the same amount on the average during the last ten years.

The same increases in the cost of labor, materials and equipment which are thus affecting additions to property are also affecting similarly the cost of labor employed and of equipment and supplies bought for operation, maintenance and replacements. Therefore, if the railways are to be able to maintain their physical properties to the same standards and to replace those which wear out or become obsolescent to the same extent as heretofore, they will have to earn enormously larger sums for these purposes than they have required in the past. It is, however, vitally important to the welfare of the American public that the railways shall be enabled throughout the war to maintain their properties in at least as good condition as they are in now. There already is so much deferred maintenance of equipment and of roadway and structures that the amount of materials and labor used in maintenance ought to be increased rather than diminished. Unless the railways are fully maintained there is grave danger that they will practically break down, and even if they should not break down during the war, failure to maintain them would leave them in a poor condition to co-operate with the industry of the country in the intense international commercial warfare which is sure to be waged after the war is over.

Federal and State Regulation

No fair minded and reasonable man can have observed the course of developments in the railway field within recent years, and especially within the last two years, and read the testimony which has been introduced in the 15 per cent rate case without being convinced that the railways cannot possibly render the government and the public the service needed from them during the war, and at the same time keep solvent without general increases in rates. That the Interstate Commerce Commission will grant some increase in interstate freight rates now seems highly probable. But this is not all that ought to be done. The Commission ought not to be expected, while there are state as well as interstate regulating authorities, to assume the entire responsibility of providing for the necessities of the country's transportation system, nor ought the entire burden of providing for them to be put on interstate traffic. The Interstate Commission already has authorized increases in passenger fares until in large parts of the country the interstate fares are higher than the state fares. Its regulation of freight rates has differed so widely from that of many state legislatures and commissions that in many cases inter-

state freight rates also are higher than corresponding state rates. This is manifestly unfair not only to the railways but to interstate shippers of freight.

In some of the states the legislatures are still in session, and if disposed to do so could so revise their passenger fare laws as to make them harmonize with the orders which have been issued by the Interstate Commerce Commission. The same statement applies to freight rates in those states in which excessively low maximum rates have been prescribed by legislation. In many states where the legislatures may fail to take any action or where they already have adjourned, the state commissions have power, after hearing, to make reasonable changes in freight rates, and some have also the same power with respect to passenger rates. In a large number of states the railways at the same time that they petitioned the Intersate Commerce Commission for a 15 per cent increase in freight rates presented similar applications to the state regulating authorities.

It is difficult to believe that any public body can fail to see that whatever may have been true before the war, it is a fact, now that we are in the war, that good and adequate railway transportation is vital to the welfare and safety of the nation, and that, therefore, it will be far better for public authorities to err in dealing too generously with the railways than to err in stinting them to the point where their service will break down.

Should the Interstate Commerce Commission deal in a broad and intelligent way with the situation and the state authorities refuse to do so the course which the national government ought to take seems clear. Almost as soon as war was declared the national administration, through the Council of National Defense, communicated to the railways its desire that they so organize themselves as to lead to the greatest possible expedition in the movement of freight. In carrying out this suggestion they are disregarding the Sherman anti-trust law, and the decisions affecting railways which the courts have rendered under it. Probably the enactment of the bill regarding priority of shipments now pending in Congress would relieve the railways from this difficult position.

At any rate, the railway managements are performing what the national administration and the chief executives of the roads consider their patriotic duty regardless of legal technicalities. The policy which the railways have adopted subordinates the selfish interests of individual lines to the welfare of all and of the nation. The Railroads' War Board, in the interest of national transportation efficiency, already has caused some steps to be taken which are directly beneficial to some roads and disadvantageous to others. It will have to take other steps in the same direction before the war is over.

When the railways, at the suggestion of the national government and in the promotion of the national welfare, are making such efforts and sacrifices as they are, should regulating authorities be allowed to act on political or selfish local considerations so as in any measure to defeat their efforts? The answer seems obvious enough. If the state authorities fail to act in harmony with the national authorities—if on the contrary they follow policies which tend seriously to hinder the railways in their efforts to render the country in this emergency the maximum amount of useful service—it will become the duty of the national government to the American public, to suppress the activities of the state regulating authorities at least during the period of the war. The inconsistent and conflicting regulation to which the railways have been subjected by Congress, the Interstate Commerce Commission and the legislatures and commissions of the various states—totaling approximately 100 different national and state regulating bodies—had grown almost intolerable even in time of peace. It would be entirely intolerable in time of war.

As important as it is that the railways should be allowed by the national and state authorities to make such increases in rates as may be necessary to enable them adequately to increase and maintain their facilities, it is even more important that the authorities should support them in their efforts to secure the greatest practical utilization of existing facilities. To this end there are numerous activities of the regulating authorities and numerous laws affecting railways which might well be suspended during the war.

Why Continue the Valuation?

One of the most conspicuous of these activities is the valuation of all the railways which is being made by the Interstate Commerce Commission. Its practical worth even under normal conditions would be highly questionable. The arguments against a continuance of it under present abnormal conditions are numerous and convincing. Some of these arguments are as follows:

1. A satisfactory valuation could not be useful for any purpose connected with the regulation of rates except the purpose of determining whether rates in effect or proposed were confiscatory. But at the present time the thing which is vitally important for regulating bodies and the public to know is not whether any existing or proposed rates are or would be confiscatory, but what rates are needed to enable the railways efficiently to develop, and maintain and operate their facilities. The most perfect valuation that could be made would throw no light on this question.

2. Chaos rules in the work of making the valuation. The widest differences of opinion prevail, even between federal and state authorities themselves, as to what are its purposes and as to how it should be made.

3. Even if the Commission should go on and finish the valuation it would be so out of date when completed as to be useless as a basis for the regulation of rates. The Commission said in its annual report for 1916: "If the same rate of progress should be maintained in the field for the future as during the past year our road and track surveys should be completed by January 1, 1920." In another place it said: "All the principal carriers were required to report actual prices paid by them for railway material and labor during the five years, and in some instances during the ten years, preceding June 30, 1914." Of what value as a basis for the regulation of rates would information regarding the prices paid during the five or ten years before 1914 be in a valuation, the road and track surveys for which will not be finished until six years after that date, even though throughout the six years following 1914 prices had undergone only normal changes?

4. As a matter of fact, however, during the last eighteen months there have been enormous increases in the prices of railway materials and equipment, and present indications are that there will be no substantial reduction before January 1, 1920. Of what value, then, will information as to unit prices prior to 1914 be in making a valuation to be applied after January 1, 1920? Is the valuation to be based upon the average unit prices prevailing in the five years ending with 1914, or in the five years ending with 1920? Are the freight cars on the railways of the United States to be appraised at the old price of $1,000 each, or at the new price of $2,000 each. Are locomotives to be evaluated at the old price of $22,000 each, or at the new price of $47,000 each? Are the rails in track to be evaluated on the base of a purchase price of $28 a ton, and a deduction for depreciation, when those same rails can be taken out of track and sold as scrap at $35 a ton? The great changes which have taken place in unit prices are alone sufficient to make preposterous the continuance of a valuation predicated on the conditions which existed prior to 1915. A mere transfer from the unit prices prevailing to those being paid now probably would add billions of dollars to the valuation.

5. Both the government and the railways need every competent man available for performing their functions in

the war. The government now has about 2,500 employed on the valuation and the railways about 7,500. They are very high grade men—most of them technically educated engineers. Up to January 1 the valuation had cost the government $9,300,000, and it was estimated that the average expenditure would be $3,500,000 per annum during the next four years. The total cost to the railways has been and is continuing to be two or three times as great. In view of the conditions, can there be any justification for keeping on the valuation approximately 10,000 men who can serve their country a great deal better elsewhere, and for spending on it from $10,000,000 to $15,000,000 a year, which can be used a great deal better elsewhere?

Unproductive Improvements

One of the important ways in which the regulating authorities can help the railways to help the country in the present emergency is by refraining from compelling them to spend money for unproductive permanent improvements, which under normal conditions might or would be desirable, but which under present abnormal conditions must be postponed if the roads are to make the most efficient use of all the money they have available in handling the traffic. The elimination of grade crossings is an improvement of this kind. It is manifestly desirable that in course of time all dangerous grade crossings shall be eliminated. The nation, however, is confronted by a danger far more serious than that presented by grade crossings. There are 256,000 grade crossings in the United States, and the number of people killed at them averages about 1,100 a year. Serious as is this destruction of life, it is negligible as compared to the destruction of American lives and property which might result from a break-down of transportation facilities during the war. It costs on the average about $50,000 to eliminate a grade crossing. Under present conditions that much money will buy a freight locomotive or 25 freight cars. The elimination of grade crossings will not affect the conduct of the war, but the provision of freight cars and freight locomotives may, and probably will, affect it to an important extent. It is to be hoped that state and municipal authorities having authority over the subject of grade crossing elimination will not fail to recognize this fact and act accordingly.

No Legislation to Prevent Strikes

The greatest disaster from a transportation standpoint which could occur to the nation while engaged in war would be a strike which would stop or even to any considerable extent interfere with the operation of trains. There is now no immediate prospect of any serious controversy arising between the railways and their employees in train service, and perhaps the patriotism of railway officers and train service employees may be relied on to prevent a strike in that branch of the service. But in the crisis last spring the railway managers acted much more patriotically than did the train service employees. In spite of that the government has not seen fit to rely implicitly on the patriotism of the managers. Congress has passed special legislation giving the President extraordinary authority over the operation of the railways in case of military need and also empowering the Interstate Commerce Commission to control the distribution of cars. There is equal need of legislation to give the government power to take any steps which may be necessary to prevent strikes.

This legislation should apply not only to threatened strikes in train service, but in the shops, for a serious strike in the shops would speedily interfere with adequate maintenance of equipment and demoralize train service itself. It is a remarkable fact, in view of what occurred in this country last September and again last spring, that Congress has not included in its war measures any legislation affecting railway strikes.

Wasteful Labor Legislation

One of the worst examples of the numerous kinds of laws to hinder the economical operation of the railways which the various states have passed are the excess crew laws. It is estimated that as a result of these laws the railways are now employing at least 6,000 trainmen, who render practically no service of any value. The railways and the nation have need of these men elsewhere. The New Jersey legislature at its last session repealed the excess crew law passed in that state in 1913 and gave to the public utilities commission the authority, after notice and hearing, to direct common carriers to employ such number of employees as the commission shall deem adequate and necessary for the protection of the public and railway employees. In most of the states, however, all efforts to secure the repeal or modification of these unnecessary and wasteful measures have proved futile. On the contrary, some of the legislatures at their sessions this year have passed measures tending to hamper the railways in employing competent men and making the most efficient use of them.

Train Service and Car Service

In order to enable them to render the maximum amount of useful service it will be necessary for many, if not most, railways to make extensive changes in their train service. In many parts of the country there is rendered an excessive amount of passenger service. The elimination of passenger trains not really needed by the public will render available more men and fuel with which to operate freight trains, and there are not a few fast freight trains which also could be cancelled with benefit to the service in general.

In many states, however, the state commissions have large authority over passenger train service, and there are, unfortunately, indications that some commissions intend to use it without much regard to existing abnormal conditions. The chairman of the Oklahoma Corporation Commission has issued a statement indicating that that commission will resist efforts to make reductions in passenger service. In Texas some years ago the state commission issued an order which, in substance, requires the railways when a passenger train is more than thirty minutes late, to send forward another train. The railways, in view of the present emergency, have tried to get this order suspended, but, at latest reports, unsuccessfully.

The situation with respect to the movement of freight is of course the most serious affecting transportation with which the railways and the nation are confronted. Because of the large increase in both commercial and government business, and especially because of the enormous increase in export business, the supply of freight cars has become inadequate, and only by making the best practicable use of the available supply, having regard to the interests of the country as a whole, can there be prevented from developing a situation much more serious than any which has previously existed. In recognition of this fact Congress has passed a law empowering the Interstate Commerce Commission to control the distribution of cars, and a bill is now pending designed to give the President authority to direct that certain kinds of traffic or particular shipments shall have preference or priority in transportation. Another part of the bill provides that carriers complying with such orders of the President, or of the agency to which he may delegate such authority, shall be exempt from the penalties or liabilities imposed by existing laws on account of any such action. If this becomes a law it would seem to remove any power on the part of state authorities to directly interfere either with the reduction of passenger service, if it shall become necessary, or, indeed, with any step which may be taken to enable the railways to deal with the emergency with which they are confronted. In order to expedite the handling of cars by shippers and consignees the Interstate Com-

merce Commission after conferences with the representatives of organizations of large shippers has authorized the railways to increase demurrage rates, and the railways themselves voluntarily have created a practical pool of all their box cars.

There are numerous state laws which, if enforced as they stand, would seriously interfere with all the efforts being made to secure the greatest utilization of the existing facilities. One class of these measures are those known as "reciprocal demurrage laws." These fix the times within which the railways must furnish specified numbers of cars to shippers, and provide penalties for failure to do so. The legislature of Kansas added another to the number of these laws this year. This provides that railways, after a written application to a superintendent, agent or other person in charge of transportation, must on order from a shipper furnish ten cars within three days, ten to thirty cars within six days, and thirty or more cars within ten days. In emergencies the state public utilities commission is authorized to specify the class of cars which must be furnished for the transportation of different classes of commodities. In Nebraska it has been proposed to empower the railroad commission to require the railroads to purchase and provide cars and other equipment when needed. It is impossible to see how the Commission on Car Service, or the Interstate Commerce Commission itself, can secure the most efficient use of cars for the country as a whole if it should be interfered with by state regulations of this character.

Carload Minimums Should Be Advanced

The railways are required to specify in the tariffs they file with the Interstate Commerce Commission the minimum carloads on which shippers can get carload rates and no advance in minimum weights can be made without the approval of the Commission. A number of states not satisfied with classifications of freight which are accepted by the Interstate Commerce Commission, have adopted classifications of their own, and these fix the minimum carload weights within those states. In order to secure the heavier loading of freight cars now imperatively needed, there ought to be numerous advances in minimum carload weights. The Interstate Commerce Commission from time to time has authorized increases in minimum weights and there seems to be no reason for doubting that it will authorize others as the railways may present to it the need for them. Already in many cases the minimum weights on interstate shipments are higher than those on state shipments, and unless the regulating authorities of many states assume a different attitude from that which they have taken in the past this disparity will increase. It is needless to say that every needlessly small carload shipped under these state regulations involves a loss of economy and efficiency to the transportation system of the entire country.

Attitude of State Authorities

It would not be fair lightly to assume that all the state regulating authorities in dealing with questions affecting the work of employees and rates and service will resist the efforts being made by the national authorities and the managements of the railways to enable the railways to play with the greatest efficiency their part in the war. In fact, many members of state commissions that have conferred with the Railroads' War Board have promised their hearty co-operation, and many of the state commissions as well as the Interstate Commerce Commission have already done a great deal to promote the campaign for heavier loading of cars and more prompt loading and unloading. Failure on their part to act fairly and intelligently regarding rates would have sufficiently serious results, but hardly so serious as those which might be caused by interference with the efforts which are being made to secure the greatest efficiency and adequacy of service. It has been evident to students of the railway situation for years that sound and beneficial regulation of railway operation by the present multiplicity of regulating bodies is almost impossible. Persistence by the state authorities in the present crisis in the effort to regulate the railways for the furtherance of local and state interests and without regard to national interests would afford an argument of great power for wiping out state lines in the regulation of railways.

THE TELEPHONE AND TELEGRAPH MOBILIZED

Announcement was made recently that the Council of National Defense had met with hearty co-operation from the telephone and telegraph companies in its effort to mobilize the wire facilities of the nation for war purposes. The government is able to command the use of 20,000,000 miles of exchange and toll lines, which connect 10,000,000 telephone stations.

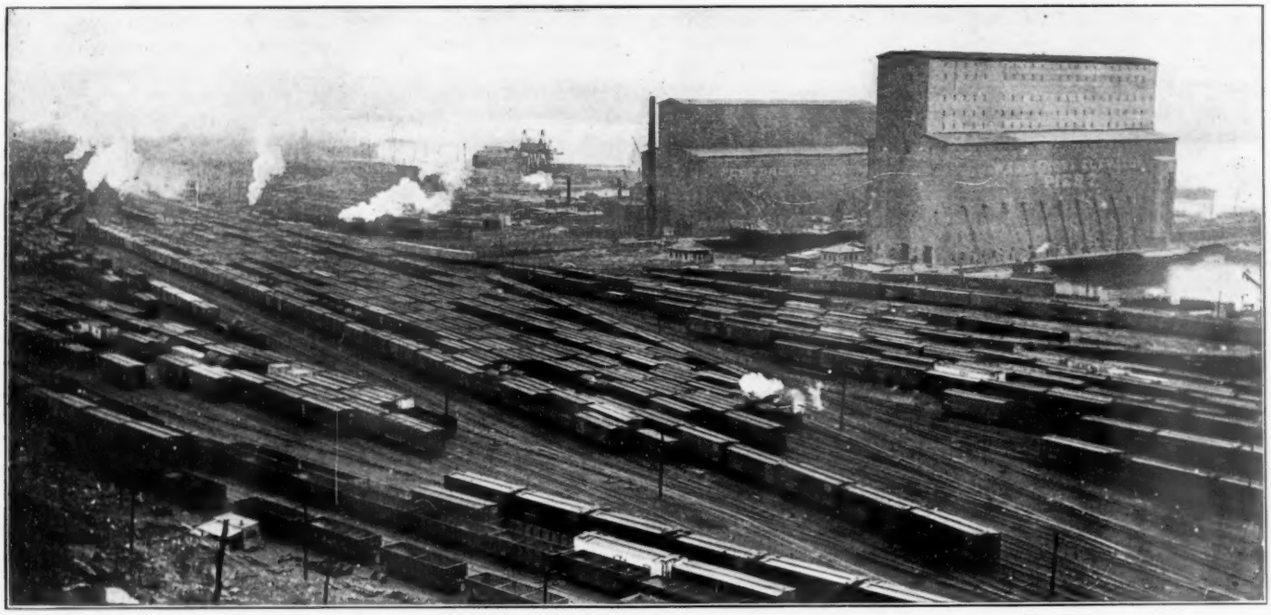
All government messages are being handled on a preferential basis, with right of way over commercial messages. These include the private branch exchanges of all great utility, industrial, and transportation companies; all the great commercial and financial establishments of the United States, and gives government officials access to the various centres of activity.

As a means of insurance against interruption there are many alternative routes between the important points of the country. These can be utilized almost instantly for communication between any two points should an interruption occur because of flood, storm, or even foreign occupation. It appears impossible to cut off communication between any two important points for even negligible spaces of time.

When the war in Europe began there were some outlying places not connected by long lines capable of commercial transmission of telephone messages. Since then the American Telephone & Telegraph Company has extended its lines across the continent and so improved transmission that it is now possible to communicate by long-distance telephone with any section of the United States. As an instance may be cited the new line down the east coast to Key West, Fla., which probably will not be commercially self-sustaining for many years, but it was done in anticipation of the needs of the government, and the strategic importance of having not only the whole Atlantic coast, but the entire country in speaking distance of Washington.

The telephone company also has placed at the disposal of the government all the resources of its manufacturing facilities, employing thousands of skilled workers. It also is doing a great deal of construction work at the request of the government, and every facility of the system is at the absolute and preferential command of the government.

Inefficient Railroads Deepen Austrian Problem.—A staff correspondent of the Associated Press quoted in the New York World says that Central Europe's food problems have, during recent months, been adversely influenced by the fact that slowly the railroads are losing their efficiency and are no longer able to do their share in the distribution of these necessities. The war has made heavy demands upon the lines and it has been impossible to give trackage and rolling stock the care they require. For almost two years now the railroads have been neglected. Lack of skilled labor has prevented the state and private railroads from keeping the rolling stock in good repair. This compelled a lessening in the speed of trains. A reduction of carrying capacity of the roads resulted from this. Locomotives are in poor condition and steam issues from their leaking joints. Hardly a week passes without a wreck. Most of these occur to freight trains since the sweeping reductions in the speed of passenger trains were made last fall. Last winter thousands of tons of potatoes and other vegetables were ruined in this manner.



Conditions in the West Shore Yard at Weehawken, N. J., Last Winter.

Speeding Up the Operation of Terminals

The Present Conditions Demand the Highest Efficiency in Yard Work to Prevent Traffic Blockades

THE primary duty of the railways of the United States at the present time is to make every possible preparation for the expeditious movement of the traffic which they may be called upon to handle during the war. A breakdown in transportation facilities in such a way as to endanger the adequate support of our forces in the field might cause a national catastrophe.

When considering ways to increase the efficiency with which the railways are operated and primarily to enable them to handle more traffic, one naturally looks to the points of most limited capacity where congestion is first evident. On American railways this leads at once to the freight terminals, for with relatively few exceptions the lines between terminals can handle more traffic than the terminals themselves can classify and pass to them. In other words, the terminals constitute the weakest link in the railway transportation system of the country today, and their limitations are therefore of great concern in these times of heavy traffic and national emergency.

One need only consider the conditions which have prevailed during recent months to realize the importance of the terminals. Not only were the railways called on to handle the heaviest business ever received, but that part of the traffic intended for export so exceeded the capacity of the boats available to transport it across the ocean that a vast accumulation of cars resulted at the Eastern seaboard. The immediate effect was to blockade the tidewater terminals completely, and this blockade extended inland until points as far west as Chicago and St. Louis were in almost as serious condition. While the primary cause of this blockade was beyond the control of the railways and was one for which they were not responsible, the heavy movement of traffic resulted in congestion at terminals removed from the seaboard and demonstrated the inadequacy of the facilities at many points.

The probable trend of traffic during the war is discussed in another column, and it is sufficient to say here that, if the experiences of England, France and Canada are any guide, a heavy increase in traffic over that now being handled may confidently be expected. The roads are thus facing the problem of having to handle a considerably heavier traffic than that which taxed their terminals to the limit last winter without an opportunity to increase the capacity of these facilities to any considerable extent by the construction of new tracks, etc.

The importance of terminals to the operation of a railway as a whole is indicated by an analysis of a typical journey of a freight car, made recently by a statistician of a western railway, and based upon the statistics of the Interstate Commerce Commission for the year ending June 30, 1914. From this data the average trip was found to consume 17.72 days, during which time the car traveled 260.19 miles under load and 124.14 miles empty. On this trip the car spent 1.6 days in trains, two days with the shipper for loading, an equal time for unloading and 12.12 days, or 68 per cent of the time, in yards, in interchange between roads, undergoing repairs, standing idle, etc.

The largest part of the car's time is spent in yards. This is indicated by the fact that roads moving cars long distances without having to put them through and hold them in many large terminals make a much greater mileage per car per day than those as to which the opposite is true. For instance, in the fiscal year ending June 30, 1916, the average miles made per car per day on the Union Pacific reached the remarkable figure of 73.5, while on the Pennsylvania Railroad, with its large eastern terminals, this figure was only 24.19, and on the New Haven only 14.20 miles. The effect of large terminals upon car movement and upon railway operation in general is further evidenced by the statement that there are probably at all times in the 15 largest terminals of this country approximately 1,000,000 cars, or 40 per cent of the entire number in this country and four times the number estimated to be in trains between terminals.

The most serious need of the railways at present is more ton miles per car per day. Because of this fact, any

measures that will shorten the time required for a trip (equivalent to increasing the number of cars available) is of primary importance. As only 1.6 days, or 9 per cent of the time, is now spent in trains it is evident that the opportunity to effect an improvement through increasing the speed of trains is limited. Also any attempt to reduce the time now allowed shippers at the beginning and end of the journey may be expected to meet with their opposition and only limited improvements can be expected here, at least in the near future. Therefore, improvement must be looked for chiefly in the 12 days now spent by the car in yards where it is under the direct control of the railway. If the total

Terminal Congestion at a Tidewater Terminal Last Winter

time required per trip could be reduced to 15 days by cutting down the time spent in yards and otherwise unaccounted for to 9.4 days, it would be equivalent to placing about 400,000 additional cars in service.

The capacity of a railroad can in nearly every case be increased almost in proportion to the extent to which the capacity of its terminals is enlarged. The capacity of terminals can be increased either by adding to or rebuilding existing facilities or in many cases by the adoption of more intensive methods of operation. Impressed with the experience of 1907 the railways have made large additions to their terminal facilities during the last decade. However, during this period the traffic has also increased, the ton miles of freight carried during the fiscal year ending June 30, 1916, being 43 per cent greater than for 1907, while the business now being handled shows a large increase over that of a year ago. Because of this fact the terminal facilities of the railways are probably as seriously inadequate to-day as they were 10 years ago.

One cause of inadequate terminal facilities is an absolute shortage of tracks. Another and equally serious cause is an obsolete arrangement or location which prevents the best use being made of the facilities existing. This is a common condition in yards, created primarily by the addition of a few tracks at a time to relieve a particular situation until almost all evidences of an orderly layout are lost. The expenditures required for the complete reconstruction of the terminal facilities at any point are so large that it is natural for a management to hesitate to abandon facilities already existing and commit itself to the construction of a new terminal as long as the older one can be made to perform the service. While perhaps satisfactory during normal times, facilities which have been outgrown are not only highly expensive to operate but are the most difficult to keep free of congestion during heavy business.

The need of increased terminal facilities has been the subject of extended discussion during the last few years and the urgency of this problem is generally realized by railway men. However, much work of this character has been postponed from year to year because of the limited earnings of the roads, and continuing periods of depression which have lessened the demands for more facilities. Now, when the roads are handling a traffic 40 per cent greater than that of two years ago, the need of more facilities is evident and any construction work which will provide improvements of this character should be expedited as much as possible in order that the roads may secure the benefit from them at the earliest practicable date.

Relief, however, does not depend entirely upon the construction of more tracks. Many times a slight rearrangement of the existing tracks will eliminate the points of congestion and delay. Frequently more supervision and the rearrangement of schedules of crews or of methods of operation will permit more cars to be handled with the existing facilities. The present conditions justify a thorough analysis of the possibilities of existing terminals so that, because of the large amount of reconstruction work needed, energies may be concentrated on those which are most urgent.

Difficult as it is to establish a high esprit de corps among the ranks of organized labor, the present situation calls for extra efforts on the part of men of all classes, organized and unorganized. An indication of what can be accomplished by team work and energy is given by the performance made at one large yard where it became desirable to expedite the movement of a certain group of time freight trains through the terminal. The classification of these trains had formerly required approximately 10 hours and had taken the time of one shift of men. The switching crews engaged in this work were told of the desire to facilitate the movement of these trains through the yard and the men were promised that if they would hasten the work the time saved would be theirs, the company's sole desire being to expedite the forwarding of the trains. The result was that by watching their opportunities to prevent delays the employees saved about four hours of the time formerly required. The immediate advantage of this was ability to shorten the schedules of part of these trains and to load others more heavily and still maintain the existing schedules. In a congested yard the effect of such a saving in time would be to increase the capacity in proportion to the amount of time saved.

In England it has been found that the output of those employees engaged in war-time operations is considerably greater than that of other employees doing the same work

An Important Eastern Terminal During the Blockade Last Winter

on commercial products. As the railways are the third arm of the government service, there is the same opportunity for the display of patriotic endeavor in expediting the work of transportation as in munitions plants. Under present conditions any increase in the number of cars which are handled through the terminals raises the capacity of the roads by that amount and decreases the delays to military and commercial shipments accordingly. There are many opportunities to speed up operations, but the railways must ordinarily be willing to divide the benefits so secured with their employees, a practice which has not always been fol-

lowed in the administration of the bonus system and similar plans to increase output.

At no time can the railways undertake an analytical study of the methods of operation at their different terminals to better advantage than at present. It is true that all methods are not suitable for universal application, but it is equally true that many ideas developed at one point can be applied elsewhere to advantage. Realizing this, several roads have employed inspectors of terminal operation whose duty it is to correct inefficient practices, to make the best ideas of one yard available for all, and to raise the standards of terminal operation over the system. The railroads of this country are in general suffering from too little supervision of terminal operation, particularly from the standpoint of the systems as a whole, and the adoption of some such method will do much to overcome this objection.

The Use of Embargoes

The first effect of congestion in a terminal is to slow down operations and to decrease the number of cars which can be passed through the yard. To attain the highest capacity it is, therefore, important to prevent the undue accumulation of cars at any one point. This leads to the use of embargoes. With the conditions of last winter still clearly fixed in their minds, railway men are familiar with embargoes and with their use. A considerable amount of the trouble last winter resulted from delay in the placing of embargoes. Cars accumulated at the eastern seaboard in such numbers that the yards became blocked and their capacity was reduced, resulting in still further delay to those cars which could be unloaded. The complexity of car movement in this country and the large number of roads which interchange traffic makes the placing of embargoes a problem of unusual complications. In Canada, where the number of roads is limited, the problem is much simpler. At the same time, the Canadian roads have been more prompt to place embargoes, and as a result the situation at their terminals has not been as serious as in the United States. The roads of this country can afford to use the embargo freely to keep their terminals open. Rather than delaying traffic, the embargo is a means of expediting it by preventing the terminals from becoming blocked and their capacity from being reduced accordingly.

The Joint Operation of Large Terminals Desirable

Important as a better operation of the individual terminals of the different roads to the transportation industry of the country is at the present time, even this is secondary to the solution of the problems presented in the large railway centers where, because of the heavy interchange of cars, the individual terminals merge into one large unit and are mutually interdependent one on another. The added complications resulting from these conditions lead to even greater delays to cars at these points than at the isolated yards while the results of inefficient operations are more serious.

In general, it is the practice of the various roads to operate their terminals at such centers with little regard for the interests of other roads or for the promotion of the interests of all. Little effort is usually made to co-ordinate the activities or to eliminate duplication of facilities or of work. The active competition for business between the different roads has built up a strong spirit of jealousy, leading to the protection of the interests of the individual road frequently at the sacrifice of those of the roads in common. It is this problem which makes it difficult to promote any method of co-operative action.

This difficulty has been evident in its greatest intensity at Chicago. This is the greatest point of interchange in the United States, although the conditions existing there are typical, except in degree, of those found at many other places. Thirty-one trunk lines owned by 24 different railroads enter this city and haul approximately 20,000 cars in and out daily, about one-half of which number are destined to points beyond Chicago, and must, therefore, be transferred from one road to another. Previous to two years ago 70 per cent of this interchange traffic was delivered directly into the yards of the receiving roads by transfer crews from the delivering lines, and 30 per cent was interchanged over belt lines. This direct delivery was made through the most congested terminals of the city and not only added materially to congestion at these points but also resulted in serious delays and in unnecessarily high cost.

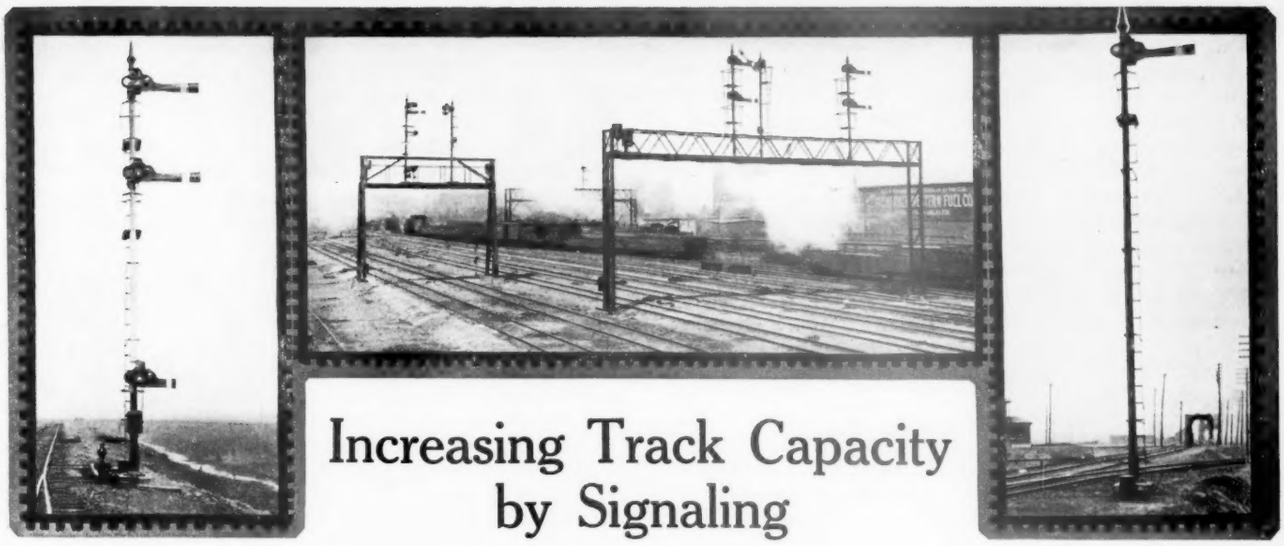
The situation has been relieved materially during the last two years by the taking over of the Belt Railway of Chicago by 12 railroads which are using it and the large Clearing yard jointly for interchange between these roads and some other tenant companies. The improvement following the consolidation of these facilities has been marked, although it affects only part of the traffic passing through the city. However, it is indicative of the advantage attending the combination of interests and the consolidation of terminal facilities at such points. The co-operative operation of terminals has been developed to the highest point in St. Louis, where the Terminal Railroad Association is the joint agency of all the railways entering that city in the operation of the terminals at that important center. The benefits to the railways from such consolidation is so marked through the elimination of duplication of facilities and the resultant economies in operation that it is surprising that the same general plan has not attained greater success in overcoming the individual jealousies of the railways at other places.

The railways of the United States have pooled their interests for the period of the war, and have agreed to accept the instructions of the Railroad War Board regarding many of the things most vital to their individual interests. They should do no less in the operation of their terminals, as a measure of service to the country through eliminating waste motion and thereby increasing their capacity and also as a means of economy to themselves. There will never be a more opportune time for the roads to work out methods for the joint operation of their terminal facilities than the present, and the results, while highly important during the period of the war, will be equally satisfactory after peace has been restored.

NATIONAL RAILWAY EFFICIENCY

With the eyes of the world and the eyes of posterity upon us, we must prove our boast that the American railways are the finest, the most efficient, the most capable of meeting an emergency, that the world has ever known.

We must show our Allies that our entrance into the war strengthened our transportation system and did not weaken it; and our enemies, that the personnel of American railways is, to a man, doing its best to back up at home the fighting efforts of the boys in the trenches. The way in which we can do this is to make every man-day in railroad service count in the fight for conservation of labor at home and abroad; to make every pound of material give forth the greatest service that can be wrought from its use; to make every freight car carry its full capacity (and a little more) so that there may be more cars to carry the commerce of the nation and its munitions of war; to make every locomotive pull its full rating during every available moment so that we may have more engine power with which to haul our men and fighting material toward Europe and the trenches. Not until every man in railway service in this country has promised upon his honor to consecrate himself to this doctrine, regardless of his affiliation to anything other than the national railway service, can it be said that the American transportation system has done its bit toward ending the world war through the early victory of the United States and its allies.—*William S. Wollner, assistant to the chief engineer, Northwestern Pacific, before the Pacific Railway Club.*



Increasing Track Capacity by Signaling

A TEN per cent increase in track capacity on a busy division as a result of proper signaling may be just as important as a ten per cent increase in motive power, and under present conditions would probably be easier to secure. Roads that are now being called on to move every ton of freight possible on certain lines and anticipate even greater demands as the requirements of the war develop, face a most serious problem in this matter of capacity. The various methods of getting more trains over a given line must be carefully considered for each individual case, and that means adopted which is most feasible and best suited to conditions. In any such consideration, however, safety must be kept constantly in mind. "Running by smoke" is a time-honored way of increasing capacity, but in this case time-honored means dishonored. No road can afford to increase capacity at the expense of safety.

A brief review of the experience of the past may throw some light on the present. The business handled by American railways has increased tremendously in the last 25 years. From 1891 to 1916 the average annual rate of increase was 12.78 per cent for freight traffic, and 6.5 per cent for passenger traffic. During this period an equally rapid development in the capacity of equipment and operating methods was going on, with the result that taking the average for the country as a whole, the train density remained practically the same. This does not mean, however, that there have not been divisions and even entire roads on which the train density has increased materially.

On the contrary, there have been many such cases. The monthly earnings figures, which are the only statistics available as to the business handled since June, 1916, show that for nine months the total operating revenue was 12 per cent greater than for the corresponding period of the previous year. So it is apparent that at least the normal rate of increase is being maintained over 1916, a year which itself set new high records. The extreme demands on equipment builders and company shops will make it very difficult to effect more than normal increases in average locomotive and car capacity during this emergency period, and increases in traffic can, therefore, be expected to result in at least normal increases in train density, and in more than normal increases on many lines.

Signaling and interlocking have played a prominent part in solving past problems of handling dense traffic by reducing the safe interval between running trains and eliminating unnecessary stops. They can be used with equal value in meeting present problems of this kind. A clear distinction should be drawn, however, between the justification for signaling under normal conditions and during the present emergency. There have been installed up to date approximately 5,000 interlocking plants and 33,000 miles of automatic signals. Much of this work was done primarily to secure increased track capacity, and has produced the desired result. In other cases this factor, coupled with increased safety prompted the expenditure, and in still others, safety for high-speed passenger service, largely as an advertising asset, was the governing consideration.

Under present conditions it would be very hard to justify an expenditure for signaling on the ground mentioned last. However, the first consideration, increased track capacity, and the second, safety, are just as important as ever, and the number of points at which they will apply is probably

Signal Situation and The War

ABNORMAL increases in train density are likely to occur during the war.

Signaling and interlocking can in many cases so increase track capacity as to offset such increases.

One road increased the average speed of freight trains between terminals from 13½ to 15 miles an hour on one division by automatic block signals.

An interlocking plant will probably save its cost if it eliminates stops for twenty trains daily.

Every available means must be utilized during the war to maintain existing facilities to a high standard.

greater than at normal times. Such points include particularly junctions and crossings made important by war time traffic, entrances to yards, sections of main line on which the capacity limits the capacity of an entire division, and short unprotected sections between portions already signaled where the installation of signals to close up the gap would permit even greater utilization of existing facilities. There is apparently a tendency at present, particularly among eastern roads, to curtail their signaling programs for this year. There is danger of ill-considered retrenchments hitting projects which would really show important operating advantages if carried to completion.

Greater Capacity Through Signaling and Interlocking

When confronted by many pressing calls for every dollar available for improvements, a railway officer may have difficulty in marshalling sufficient proof of the value of an expenditure for signals and interlocking. The facts are amply convincing, however, if they are set forth in their true light. A clear-cut proof of the increase in average speed of freight trains between terminals affected by automatic signals—one of the best that has ever been made—was recently prepared by Frank L. Dodgson. The substance of Mr. Dodgson's conclusions from his studies will be found below. With through freights, something like 8 per cent better time was made, after the automatics were put in, by the elimination of delays at meeting points, the shortening of the intervals between following trains and the lessened necessity of moving at low speed under control.

Mr. Dodgson's data and calculations are of particular interest because it is usually so difficult, if not impossible, to secure all of the facts necessary to make a fair and satisfactory comparison of freight train economies in periods of time separated by so long as twelve months. Everybody interested will be cognizant of such economies, but the actual figures to prove them are usually conspicuous by their absence. The study here referred to was made on one division of the Northern Pacific. A similar improvement was made on another division of the same road, where various changes in conditions made a statistical comparison impossible but where, nevertheless, the superintendent was well satisfied of the improvement. "Now," said he, "the trips are made within the 16-hour limit without any difficulty; before the introduction of the automatics there was constant trouble in this respect."

Improving Freight Train Time by Automatic Signals

The introduction of automatic block signals normally increases the capacity of a railroad, because the interval between trains, if it be really an adequate interval—whether maintained by the manual block system or by the time-interval system—is always shortened by such improvement; but to say that the capacity is increased does not disclose the whole of the advantages gained. There is an added degree of safety, owing to the substitution of definite and simple operations for those which are uncertain and complex; and there is a reduction in small bits of lost time—analogous to what in mechanics would be termed "lost motion."

The figures which are given here are from the report of a study by Frank L. Dodgson, consulting engineer of the General Railway Signal Company, showing the saving in time that has been accomplished by the installation of automatic block signals on the Lake Superior division of the Northern Pacific, where, thanks to the patience and persistency of Mr. Dodgson, a definite comparison was found to be feasible.

Usually it is no easy matter to find two periods, one before the introduction of the signals and one after they are put in use, in which the volume of traffic is substantially the same. These Northern Pacific signals were installed in 1913; and after a survey of the November train sheets for five years (November being the month of heaviest traffic), Mr. Dodgson found that November, 1912, and November, 1916, were about alike in the amount of freight moved; and these months he took for his comparison. Even here it was impossible to make satisfactory comparisons for a whole month and so he was obliged to take 14 days in each month. With this data, as will be seen, it was possible to make two statements of train mileage in which the earlier and the later were nearly equal in aggregate amount. The number of passenger trains also remained unchanged, and there had been no changes in the length or location of side tracks which would affect the comparison.

The automatic signals between stations are so located that trains following one another are kept about 1½ miles apart.

It is desirable also to make a comparision with two periods in which the motive power was of the same class; but in this element the present study was only partially satisfactory; that is to say, a part of the locomotives had been superseded by a new type, which draw about 30 per cent larger loads than Class I. These larger engines hauled about one-third of the tonnage of the month.

The trains of the Lake Superior division run from St. Paul, Minn., northeastward to Superior, Wis., 155 miles; but a part of the line is double track and the present record deals only with the movements from White Bear, twelve miles from St. Paul, eastward to Carlton, 120 miles farther. That is to say, the record is for a single track section 120 miles long; and this length is divided at Hinckley, 55 miles from Carlton, and 65 miles from White Bear, because at Hinckley, owing to a change in ruling grade, the eastbound trains have to reduce their loads while the westbound trains can take on additional cars.

The data here given consists of the averages and totals of a statement showing the record for each day by itself. For November, 1912, the westbound record is shown in items 4 to 14 inclusive; and the eastbound in items 15 to 25 inclusive. The record for November, 1916, is shown as follows: Items 32 to 42 inclusive, westbound movements with engines of class W; 43 to 53 eastbound movements with the same class; 54 to 64 westbound movements with engines of class T, and 65 to 74 eastbound with the same class.

The meeting stations on the line, with their distances from White Bear, are as follows:

White Bear	0	Mission Creek	61
Hugo	5	Hinckley	65
Forest Lake	7	Friesland	69
Wyoming	18	Groningen	74
Stacy	22	Finlayson	78
North Branch	30	Rutledge	83
Harris	35	Willow River	86
Rush City	42	Sturgeon Lake	91
Rock Creek	47	Moose Lake	97
Pine City	52	Barnum	101
Beroun	57	Mahtowa	108
		Carlton	120

WEIGHTS AND SPEEDS OF THROUGH FREIGHT TRAINS, WHITE BEAR AND CARLTON, FOURTEEN DAYS IN NOVEMBER, 1912. ALL LOCOMOTIVES CLASS T; TRACTIVE POWER 33,300 lb.

1.	Total train miles	20,281
2.	Total train time, hours	1,497.88
3.	Average miles, per hour	13.50
4.	Westbound, first 55 miles; rating 2,300 tons—	
5.	Number of trains daily (min. 6, max. 8) average	7.14
6.	Average load, tons	2,145
7.	Average per cent of rating	92
8.	Westbound, remaining 65 miles; rating 2,600 tons—	
9.	Number of trains daily (min. 5, max. 7) average	6.21
10.	Average load, tons	2,350
11.	Average per cent of rating	91
12.	Westbound total train miles	11,126
13.	Total time, hours	794.97
14.	Average miles, per hour	14.00
15.	Eastbound, first 65 miles, rating 2,500 tons—	
16.	Number of trains daily (min. 4, max. 6) average	5.21
17.	Average load, tons	1,506
18.	Average per cent of rating	60
19.	Eastbound remaining 55 miles, rating 2,050 tons—	

20.	Number of trains daily (min. 5, max. 7) average	5.71
21.	Average load, tons	1,380
22.	Average per cent of rating	61
23.	Eastbound, total train miles	9,155
24.	Total time, hours	702.92
25.	Average miles per hour	13.20
26.	Total average number of trains run daily, both ways, including passenger and way freight—	
27.	On 55-mile section (Min. Nov. 30, 19; max., Nov. 13 and 17, 23)	20.5
28.	On 65-mile section (Min. Nov. 30, 17; max. Nov. 2, 13 and 17, 21)	19.5

THROUGH FREIGHT TRAINS, FOURTEEN DAYS IN NOVEMBER, 1916.

LOCOMOTIVES OF CLASS T AND CLASS W; TRACTIVE POWER 33,300 lb. AND 46,600 lb., RESPECTIVELY.

29.	Total train miles	20,212
30.	Total train time, hours	1,395.43
31.	Average miles per hour	14.50
32.	Westbound, *Class W,* first 55 miles; rating 3,100 tons—	
33.	Number of trains daily (min. 1, max. 4) average	2.43
34.	Average load, tons	3,013
35.	Average per cent of rating	97
36.	Westbound, remaining 65 miles; rating 3,500 tons—	
37.	Number of trains daily (min. 1, max. 3) average	2.00
38.	Average load, tons	3,454
39.	Average per cent of rating	99
40.	Westbound total train miles, *Class W*—	3,617
41.	Total time, hours	262.40
42.	Average miles, per hour	13.30
43.	Eastbound, *Class W,* first 65 miles; rating 3,350 tons—	
44.	Number of trains daily (min. 1, max. 4) average	2.43
45.	Average load, tons	1,965
46.	Average per cent of rating	55
47.	Eastbound, remaining 55 miles, rating 2,750 tons—	
48.	Number of trains daily (min. 1, max. 4) average	2.64
49.	Average load, tons	1,927
50.	Average per cent of rating	70
51.	Eastbound, total train miles, *Class W*—	4,255
52.	Total train time, hours	316.48
53.	Average miles, per hour	13.50
54.	Westbound, *Class T,* first 55 miles; rating 2,300 tons—	
55.	Number of trains daily (min. 2, max. 6) average	4.43
56.	Average load, tons	2,200
57.	Average per cent of rating	96
58.	Westbound, *Class T,* remaining 65 miles; rating 2,600 tons—	
59.	Number of trains daily (min. 2, max. 5) average	3.57
60.	Average load, tons	2,429
61.	Average per cent of rating	94
62.	Westbound, total train miles, *Class T*	6,715
63.	Total train time, hours	442.61
64.	Average miles, per hour	15.10
65.	Eastbound, *Class T,* first 65 miles; rating 2,500 tons— Number of trains daily (min. 1, max. 5) average	2.93
66.	Average load, tons	1,535
67.	Average per cent of rating	62
68.	Eastbound, *Class T,* remaining 55 miles; rating 2,050 tons—	
69.	Number of trains daily (min. 2, max. 5) average	3.86
70.	Average load, tons	1,375
71.	Average per cent of rating	67
72.	Eastbound, total train miles, *Class T*—	5,625
73.	Total train time, hours	373.93
74.	Average miles, per hour	15.00
75.	Total number of trains run, both ways, including passenger and way freight, average daily—	
76.	Carlton and Hinckley, 55 miles (Min. Nov. 3, 19; max. Nov. 2, 18 and 26, 23)	21
77.	Hinckley and White Bear, 65 miles (Min. Nov. 3 and 28, 17; max. Nov. 2 and 19, 21)	19

It will be noted that the average of the speeds for the whole movement, westbound, in 1912, was 14.00 miles an hour; eastbound 13.20 miles an hour. In 1916, westbound, class W, 13.30 miles an hour; eastbound class W, 13.50 miles an hour; westbound class T, 15.10 miles an hour; eastbound 15.00 miles an hour. These rates are computed on the time elapsed from the starting of the train to its arrival at destination, including all time lost at intermediate stations. The speed of the more powerful engines, with heavier trains, would be expected to be somewhat less than that of the smaller engines with shorter trains, and such is the fact. The class W engines made about the same speed in 1916 as was made by the class T engines in 1912. Those of Class T made, in 1916, about 1½ miles an hour better than in 1912. It will be noted that with westbound trains the direction of heaviest freight movement, the engines shown in the record for 1912 hauled 91.5 per cent of their rating while in 1916 they are credited with 95 per cent. Thus the better time was made against the drawback of heaviest loads. Ignoring this, however, there remains an improvement in speed of the class T engines, eastbound and westbound, of fully 11 per cent.

Mr. Dodgson lays special stress on the fact that increasing the capacity of a railroad is not the only benefit to be derived from an improvement in speeds. The saving in engine time may be valuable in dollars and cents, not to mention the earlier release of freight cars and the shorter working hours of the trainmen. It has been calculated on a prominent western road, that on the average, a freight locomotive spends in the hands of the operating department 47 per cent of its time; that almost one half of this is charged to terminal delays, or at least to terminal waiting and that, finally, for only 28 per cent of its time is it actually on the road in useful service. This would be 403 minutes and 12 seconds in a day of 24 hours. If, therefore, by the introduction of signals (or by any other means) fourteen trains a day could be caused to spend each a half hour less on the road the aggregate amount of time thus saved (420 minutes) would be equivalent to saving the time of one engine. And in these days that is a definite saving which every operating officer can appreciate.

Economy of Time With Train Orders

The time saved by using Form 19 for all train orders is so well understood as a definite saving that the advantage of the plan is now widely recognized. The use of the telephone for the transmission of train orders is also a very definite measure of economy. In sending orders by telephone the saving is in simplicity, accuracy and relief on the nerves of despatcher and operator; but in repeating the order there is such a definite saving of time that, for any busy train wire, the continued use of the Morse telegraph seems inexplicable to those familiar with the results of telephone despatching.

The abandonment of Form 31 eliminates the necessity of stopping trains to secure the conductor's signature to despatchers' orders and is as definite a saving as is the use of telephones; but this does not seem to be so well understood as it should be. Quite likely a comparison would show, if a comparison could be made, that the saving in time by not having conductors stop their trains to sign for orders is as great as that effected by the shortening, where telephones are used, of the time required to repeat orders back to the despatcher. On single-track lines equipped with automatic block signals, Form 19 is used exclusively, with great satisfaction, the additional safeguard afforded by the block signals being sufficient to assure the most conservative objector; but those who have adopted this exclusive use on lines not thus equipped with automatics give equally favorable testimony concerning the benefits derived; and it would seem that this testimony ought to be more carefully considered.

In this connection there is given below a brief essay on this point by John F. Mackie, the well-known secretary of the Train Despatchers' Association. It may be said also, with all due respect to the legal profession, that the defense, in suits for damages resulting from failure to act on an order, that the conductor had signed for a given order, is not such an important matter as it is sometimes thought to be. A glib-tongued lawyer can, indeed, convince the average jury, unfamiliar with railway practice, that a signature on an order is of great value; but a true and thorough exposition of the actual conditions will demolish this superficial sophistry.

Argument for Delivering Train Orders Without Taking Signature

By J. F. Mackie.*

In our opinion, the "19" train order is safer than the "31." Practically all the collisions that have occurred

*From the *Train Despatchers' Bulletin,* of which Mr. Mackie is editor.

through nondelivery of orders while the train order signal was displayed have been "31" orders. Failure to deliver by reason of nondisplay of the signal may occur under either method of delivery, but no more under one than the other. There have been cases of collision or hazard caused by failure of an engineer or both engineer and conductor to read a "19" order before fouling the entrance switch of siding from the opposing direction, but this is no objection to the unlimited but only to the limited use of the "19," under which the "19" form is used only to confer but not to restrict "right." This offers a constant temptation to an engineman to assume that a "19" order awaiting him is for the purpose of "keeping him going," and when it occurs at a point where a superior train is due or an opposing train is to be met in pursuance of previous orders, it provokes the assumption that the order in waiting will confer right to proceed against such a train. Of course, no engineer or conductor has valid excuse for any such assumption, but the temptation is plainly there and will probably continue to incite to hazard while the "19" order continues to be used only to confer Right, and human nature is what it is. This temptation would vanish at once if the "19" method of delivery were invariable. For then no engineer would dare to proceed without reading orders received, well knowing that they were as likely to restrict as to confer Right.

Under the "31" method of delivery the operator is a passive agent until the conductor reports for orders. His only responsibility is that of displaying the train order signal in proper position and properly lighted. Under the "19" method he does this, but in addition he must personally deliver the orders and clearance card to the engineer and conductor respectively, and to do this must exert himself actively to assure delivery; must be out on the platform, where he is more likely to observe whether the signal is properly displayed than if the order were a "31." In both cases, of course, he must have hand signals at hand and in readiness, should the signal fail; but from every point of view, in every action bearing on delivery, the "19" form of order is unquestionably (we think) superior to the "31." On analysis, every superiority claimed for the "31" order, even that of the reading of the order by conductor to operator and by engineer to conductor, which, by the way, the Standard Code does not prescribe, proves imaginary. No real superiority can be shown to exist, while the superiorities of the "19" order in point of safety and efficiency are apparent. So far as we have knowledge, no hazard has ever been incurred in the limited use of the "19" order that is not equally liable to occur under the "31."

The delivery of all train orders should, in our opinion, be accompanied by a clearance card, showing the numbers of the orders to be delivered, and this clearance card, also, in our opinion, should be checked and OK'd by the despatcher, who thus retains control of his trains up to almost the moment of delivery. It is a shortcoming of the American train despatching system that the despatcher's authority over train movement ends with the issue of orders for trains.

We believe that it would enhance safety and very slightly, if at all, hamper train movement if the train despatcher had full control of the clearing of trains at starting terminals, at points where orders are to be delivered to them and over trains taking the siding for superior trains, in a manner similar to that provided in Rule 365 of the Manual Block Signal rules.

Any railway is at liberty to use the "19" form of order exclusively if it so desires. A number of lines already are doing so. We can think of no reason why doing so should subject a railroad to the adverse criticism of investigating commissions and we know of no instance of any such criticism.

Economy of Interlocking—Remote Switch-Setting Apparatus

Another typical instance of the specific value of automatic signaling is furnished by a 40-mile installation on the Atlantic Coast Line, replacing the manual block system, on which 1,300 minutes of train detention were saved in one month in comparison with the same month of the previous year. In addition to this, salaries were reduced by taking off operators to such an extent that $7,000 a year was saved above the cost of maintenance and depreciation of the signals. There was, also, of course, the increased safety.

The best analysis of the economy of interlocking plants ever made was published by J. A. Peabody, signal engineer of the Chicago & North Western, in 1905. This showed that an annual saving can be effected by the installation of interlockings at crossings having 16 to 19 trains daily, and at drawbridges where the train movement is as low as 6 trains daily. While the cost of such an installation, and also the cost of its maintenance and operation have increased greatly since these studies were made, the value of saving train delays has also increased enormously. The recent Adamson law increasing trainmen's wages about 25 per cent, and the abnormal rise in fuel costs amounting to at least 100 per cent, are two items affecting this primarily. As a result, the relative economy of interlocking is probably fully as great today as in 1905.

In addition to the normal savings in fuel and trainmen's wages resulting from the elimination of stops by interlocking plants there are in some cases special conditions which greatly increase the value of such facilities. For instance, on one engine district which was studied recently with regard to track capacity, it was found that two small interlocking plants would save enough time for slow trains to make unnecessary an intermediate stop for water.

In many cases, low-voltage switch machines can be very profitably employed for the operation of individual switches where an interlocking plant is not required, the machine being controlled by an operator in a station or tower possibly at a considerable distance. The wide use of these machines since they were introduced a few years ago is sufficient evidence of the recognition they have received. On the Northern Pacific, where these machines were first used (in 1915) a marked saving is effected, at a passing track on a 94 ft. grade, by making unnecessary the stopping of heavy freight trains on the ascent. At the two switches first equipped 115 trains were thus favored in six months. This arrangement was described in the *Railway Signal Engineer* in April, 1915. There is also the possibility on almost any busy single-track line of re-arranging passing sidings at low cost with important increases in capacity. One estimate made recently on a western road showed the possibility of a 50 per cent increase by this means. Railway officers are only beginning to understand the science of passing siding location, and important developments will undoubtedly be made along this line in the near future.

Economy in Material and Labor

The two factors which will make it most difficult to carry out any extensive program of new signaling or interlocking during the war are material and labor. Every possible means for economizing in these items is, therefore, of first importance. The material situation is somewhat complicated at present by reduced capacity in some of the manufacturers' plants, but this will undoubtedly be remedied in a comparatively short time. At least the inability to secure early delivery of materials now should not alter the general policy towards such work.

The material situation can be helped to some extent by the best selection and utilization of all equipment and supplies. Standardization becomes doubly important as a means of reducing the burden on the manufacturers' shops,

and decreasing the stocks to be carried both by manufacturers and the roads themselves. The reclaiming of scrap material can also be carried further than it has been on some roads. For example, the use of a small welding outfit for repairing such metal pieces as battery chutes, cranks, detector bars, mechanism case doors, etc., is being investigated by some roads. The regular application of paint or other preservative coating to steel bridges, pipe lines, etc., becomes even more essential than usual as a means of conserving steel and iron.

The skilled labor supply will also undoubtedly be seriously affected during the war. Plans for increasing the output of each man or reducing the total amount of labor required are, therefore, of great interest. Many roads have already done a good deal to conserve labor in signal construction and are doing more now. It is a sound policy in this connection to attend to the engineering features of an installation thoroughly in the office in advance of construction operations, and then to concentrate in central shops or yards as much of the work as possible that would otherwise be handled in the field.

As illustrating the advantages of careful preliminary work, many roads have found that the preparation of typical detailed wiring plans for each location reduces the labor of installation materially. The more complete the information furnished the field men, the less time is wasted in solving engineering problems on the ground. The centralization of field work may be accomplished by establishing construction shops on large installations or by making fuller use of the manufacturer's facilities for smaller work.

As an example of actual practice in the first method may be mentioned the recently completed automatic signals on the main line of the Illinois Central, where all the concrete foundations were poured in centrally located yards and distributed by work train and derrick car, and the wiring of mechanism cases, relay boxes, terminal boards for battery wells, and the preparation of bootlegs and stake caps was attended to at the division signal shops.

The use of a manufacturer's shop for reducing field work has been carried to a great length by the Buffalo, Rochester & Pittsburgh. In installations now under construction, as in several in the past, the signals are being completely assembled at the factory and loaded on flat cars in the order needed along the line, so that they can be erected by a derrick car in a remarkably short time and with a fraction of the labor otherwise required. This system is made possible by the location of a manufacturing plant adjacent to the line; on account of the reduction in capacity of cars used for distributing the signals and consequent increase in freight charges it would not be practicable for roads at a distance from a factory. Considerable work ordinarily done in the field can profitably be handled at the signal companies' plants, however, without encountering the disadvantage referred to. One lot of material turned out recently had every mechanism case and relay box wired complete before shipment, and each went out ready for local connection, even down to a package of marking tags for the incoming wires.

In field work there are occasionally opportunities to economize labor at the expense of material. Each of these cases must be decided on its merits depending on local conditions. For example, there is little difference in the total cost of painting trunking by dipping and by applying with a brush. The former takes more paint, the latter more labor. The use of a little more cement may also at times effect a saving in labor for mixing and tamping.

Means of Keeping up Maintenance

Whatever the degree of activity in new signal and interlocking construction during the war, it is obvious that existing facilities must be so maintained as to insure their full utilization. Without good maintenance signals may actually delay traffic, while with proper care the same installation would show important advantages in expediting the handling of trains. Furthermore, the standard of maintenance must be based on keeping these facilities in proper condition not only for the immediate present, but for the entire period of the war, which is being assumed by most railway men at from three to five years. This point is vital, for a short-sighted policy in this regard might result in a condition that would later become very burdensome to the roads in trying to meet the requirements imposed by the war.

In general, the signal departments entered the present year with considerable deferred maintenance. The two years preceding 1916 were such poor ones for the railways that a hand-to-mouth existence was the best that could be hoped for in signal maintenance. The routine maintenance work was, of course, kept up, but this must be supplemented occasionally by a general overhauling of facilities with numerous substitutions of material in order to bring an installation up to standard. Such heavy work was practically abandoned during the two years referred to, and although in 1916 a good deal of it was undertaken, it was by no means all cleaned up. While it will of course be necessary in the signal department, as elsewhere, to keep some facilities in service longer than desirable under other conditions, deferred maintenance cannot be allowed to increase unduly without creating a serious danger.

The efficient maintenance of signal facilities will undoubtedly be seriously hampered by a shortage of men. It is impossible to foretell accurately how the government's military requirements will affect the maintenance forces, but as has been the case in Canada the opportunities for skilled men will undoubtedly be so great in other lines as to attract considerable numbers of them out of railway service. It is necessary, therefore, to face the problem of carrying on this work with smaller forces or with a portion of the force of lower grade. In heavy maintenance work, which is handled by gangs, some of the methods referred to under construction are applicable, but usually to a much smaller degree because the reconstruction work is of less volume and more special in nature.

In routine maintenance, the saving of labor is even more difficult. In some other departments, where the men work in groups, an expenditure of capital will usually make it possible to install labor-saving machinery. Signal maintenance, however, is practically all carried on by men working singly or in pairs, and no machine can replace human intelligence in the inspection, testing and adjusting of delicate or complicated apparatus.

The largest share of the burden of the labor shortage will, therefore, fall on the men who remain. They will be obliged to exert every effort possible to increase their personal efficiency in order to cover more work without slighting any important features. The managements have a right to expect this effort from them, and their record in the past seems to afford assurance that they will do their best. In return for such service, however, the men certainly have a right to expect from the managements as liberal treatment as possible. In some instances, the wages are too low, although such conditions are being remedied rapidly. In other cases a more human interest in the personal needs of the men by their immediate superiors would greatly increase their spirit of loyalty to the company. The nature of the work makes it very hard to arrange for any system of bonus payment for better or faster work, but any steps in this direction will be very much to the point at present.

Almost any plan that reduces maintenance labor under ordinary conditions is doubly important now. This applies to the selection of material and devices which require less maintenance, the proper organization and systematic

planning of the work, etc. In the line of selecting devices to reduce maintenance it is essential first to secure the highest possible quality. The more general use of light signals, and the further substitution of electricity for oil lamps are also worthy of consideration on this ground. Among the smaller items may be mentioned the substitution of caustic soda for gravity battery which has become quite general. While this change has been brought about largely by the almost prohibitive prices of gravity battery renewals, it also has an advantage in reducing the care which it is necessary to give the bateries.

Under normal conditions of labor supply the form of organization in which an experienced man, with one or more helpers if necessary, is in charge of a relatively small territory is usually preferred. As competent men become scarce, however, it will probably be found advantageous to adopt the alternative plan of having maintenance foremen cover considerable districts and supervise the work of comparatively untrained men along the line. The use of motor cars is quite closely related to this matter of organization. The trained men can cover more territory when supplied with these cars, and their use will probably be even more general during the war. Many roads have increased the length of maintainer's sections from 25 to 100 per cent when motor cars were installed; but there is a danger of carrying this tendency too far, as beyond a certain point it is likely to result in decreased effectiveness.

Individual planning of work by the maintainers must be emphasized to get the best results. One supervisor divides his men into two classes: Those who work hard and accomplish little, and those who work hard and accomplish more. If they will lay out a workable schedule and stick to it, less time will be wasted in jumping from one thing to another.

There may also be an opportunity for saving field men some labor by the elimination of reports. English roads have practically cut out all non-essential records, and in at least one case, they have stopped keeping performance records on automatic signal installations. While useless reports should certainly go, and every report should be carefully scrutinized as to its value, it would seem to be shortsighted to cut out anything which has as definite a value in spurring on the men to good maintenance as the comparative performance record.

Members of Special Mission Sent to France to Study Needs of French Railways at First Hand

(*See page* 1275.)

W. J. Wilgus

W. A. Garrett

Francois de St. Phalle

William Barclay Parsons

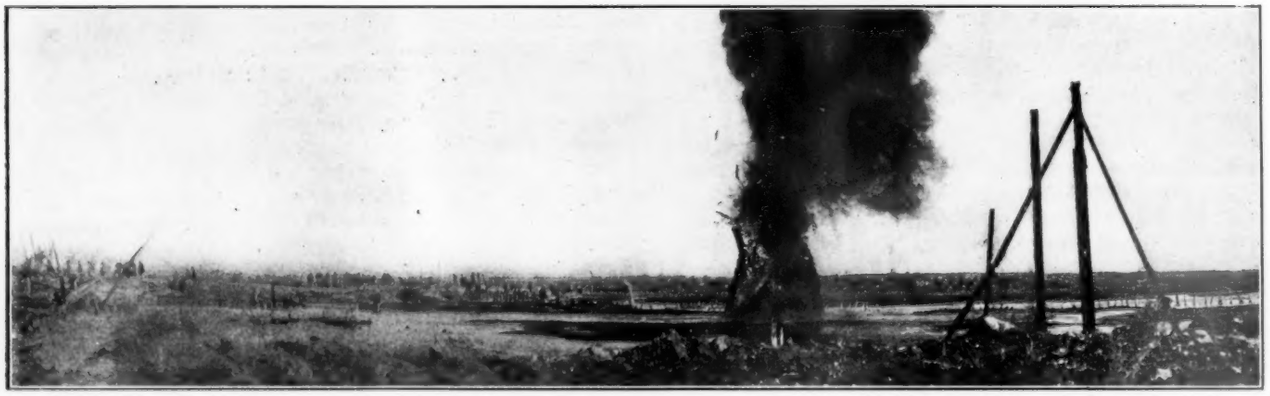


Photo from Underwood & Underwood.

British Royal Engineers Clearing Away Obstructions Which Would Impede the Progress of Advancing Troops

Cars Must Be Kept in Serviceable Condition

Thorough Repairs Vital; Betterment of Wood Equipment; Rough Handling Must Be Provided for

THE delegation of authority to the Railway War Board to operate the railroads of the United States as one system has prepared the way for many innovations previously impossible of execution which to the country as a whole are serving materially to increase the efficiency with which transportation facilities are being utilized For months past there has been a serious shortage of cars due to the abnormal amount of traffic offered and aggravated by terminal congestions which have kept thousands of cars under load for excessive periods. What may be accomplished in improving this situation under the new conditions of operation, through increased car loading and a reduction in the time of loading and unloading, is brought out elsewhere in this issue. These results, however, may not be expected to relieve the situation to such an extent that the demands upon the car department to keep every available car in condition for the greatest possible amount of service will in the least be decreased. In fact, the car department has its part to perform in still further increasing the available number of cars. What the car department may accomplish will be brought about by less spectacular methods than are being employed in other directions; the results will be obtained far less by innovations than by careful attention to the sound principles of car maintenance, adherence to which has always produced the best results.

Repairs Must Be Kept Up

IMPROVEMENT in the number of cars out of service must come from closer adherence to sound maintenance principles.

Betterment programs for wood equipment should be pushed vigorously and extended; extraordinary demands for cars may continue for many months. Draft gears and attachments, underframes, brake riggings and trucks are the essential parts.

Immediate improvement may be effected by adhering to the spirit of the M. C. B. Rules in repairing foreign cars.

Journal boxes should receive periodical attention.

A policy of building cars in railway repairs shops in general is not considered advisable. More cars can be turned out by keeping up with repairs.

Maintenance Must Not Be Deferred

The condition in which much of our equipment is found today is unfortunate. Maintenance has been deferred awaiting a cessation of supposedly abnormal business, leaving a situation of more or less unpreparedness to meet still more abnormal demands at our entrance into the European war. It is natural that on first consideration effort should be directed to tiding the equipment over the months of the coming fall and winter. In making plans for this purpose, however, it should constantly be kept in mind that very little relief in the amount of traffic need be expected for several years. The duration of the war is uncertain, but to fail to prepare for a long struggle is only to invite disaster. The situation demands therefore that betterment programs be pushed and extended rather than curtailed.

Under present conditions a decrease in the number of cars out of service for repairs presents many difficulties. Unlike locomotives, which are shopped on a mileage basis, the percentage of cars out of service for repairs reflects the quality of the construction of the cars and the thoroughness with which maintenance has been kept up, rather than the service which they have rendered. Cars too frequently are allowed to run as long as they will stay together and are then sent to the shop only to be given such repairs as are necessary to keep them in service for a few more miles. Essentially a car is not different from a locomotive; it should receive general repairs periodically. Results in decreasing the number of bad orders will depend more upon a general adoption of a sane policy of making repairs and upon improvements in the construction of weak designs than upon increased shop facilities.

A showing is often made in reducing the number of bad

order cars out of service by overlooking conditions which should send cars to the repair track, in the hope that they may get beyond the jurisdiction of the local officers concerned before failure occurs. Although an immediate showing may be made, a continuation of such a policy is sure to lead to disaster. It only results in transferring the burden to other shoulders and increases the extent of the repairs to be made. Under the present conditions of congested roads and terminal facilities, the delays caused while setting out bad order cars on the road, which should have been removed at the preceding division point or should never have been placed in the train, causes a loss of transportation efficiency far greater than can be compensated for by any increase in the available number of cars that may be effected by such a policy. At large transfer points such as the Niagara Frontier and Chicago, the number of loads which must be transferred because of defective equipment often exceeds 2,000 per month, and it may safely be estimated that for the country as a whole the number will approach 100,000 per month. This means 100,000 delays to transportation, each having a material influence upon terminal congestion. This is a serious loss of transportation efficiency which is felt throughout the country. Aside from that, it represents a direct loss to the railroads of not less than six or seven dollars per car, which is expended in transferring the load. It is evident that a policy of slighting essential repairs as a means of keeping cars in service will be of no assistance under present conditions, and should not be tolerated.

A nominal reduction in bad orders often may be made by concentrating the efforts of the repair forces upon cleaning up the cars awaiting light repairs. Such efforts are of no value except for a short time, for while the percentage of bad order cars is temporarily decreased, the amount of work which must actually be done has not been decreased in proportion. At the end of such a campaign the shops will be found congested with heavy repairs and the balance of lights and heavies, essential to the best utilization of labor and facilities, has been upset. Cars awaiting heavy repairs should be given their full share of attention. It is here that the greatest opportunity for permanently improving conditions exists. Every car which leaves the shops after a thorough general overhauling is ready to go into service and stay in service without frequent returns to the repair track.

Rough Handling Here to Stay

A great deal has been said about rough handling, which has become of such regular occurrence during recent years. Unquestionably the failure of much of the equipment to stand up in service is due to this condition, and there has been a tendency for the maintenance department to relieve itself of responsibility by placing the blame upon the transportation department It is time that the situation be faced squarely, and the fact admitted that rough handling, however far from ideal it may be from the equipment standpoint, is a necessary feature of the economical conduct of transportation. Many roads, already recognizing this fact, have inaugurated, and in some cases completed, equipment betterment programs which have materially improved the cost of maintenance, the availability of the equipment for service and the efficiency of other parts of the transportation machine.

Wherever programs of betterment of existing equipment are already in progress they should be pushed as fast as material and the cars can be delivered to the shops, and where not already inaugurated they should be more seriously considered than ever before. Of course, under present conditions the difficulty of getting cars into the home shops will seriously hinder the completion of such programs and immediate improvement may hardly be expected therefrom. But conditions of the labor and material market, as well as the demands for equipment will probably continue to grow more acute for some time to come, and as much should be done now as conditions will permit.

Reinforcing Wooden Cars

There are thousands of cars of wood construction in the country, the strength of which is entirely inadequate to withstand the shocks which must be met in heavy main line service. The parts of these cars most needing attention are underframes, draft gears, trucks, brake rigging and weak end constructions on box cars. With these rebuilt or reinforced, equipment may be placed in service and forgotten by the mechanical department for months.

Of all of these parts, the greatest difficulty is experienced with the draft gear and its attachments. Where equipment may be expected to have a life of ten years or more, it may be a matter of economy under ordinary conditions to reinforce wooden underframe cars by the use of a continuous steel center sill construction. Such a construction, however, increases the weight and under present conditions considerable difficulty may be experienced in securing the necessary material. Conditions may be improved materially, with a somewhat smaller expenditure and with a much less general reconstruction of the car by the application of steel draft arms and bolsters. This construction reinforces the underframe at the weakest points and affords a means of adequately attaching the draft gear to the car.

Weak brake beams and inadequate brake beam hangers and safety hangers are another prolific source of difficulty not only to the car department, but to the transportation department as well. Such weaknesses should be corrected without fail whenever cars pass through the shop. The damage to property and the danger to life, as well as the delay to transportation which a dropped brake beam may cause has been too generally observed to need further comment. Air brake equipment must receive thorough and honest attention. "Stencil" cleaning and repairing triple valves and brake cylinders is a practice which can be tolerated under present conditions even less than in the past.

There are many cars still in interchange service which are carried on arch bar trucks, the design of which makes them a menace to the safety of train operation. Such trucks, especially those with flat compression members should be replaced as rapidly as conditions will permit.

Box car roofs and doors have long been a source of much loss and annoyance. The provision of a good door with fixtures of approved design does not involve a large expenditure, and there is no reason why improvements in this feature of the car should not be pushed just as energetically now as in the past. Although cars with leaky roofs may be used in certain classes of service, a good roof will keep many box cars off the repair track.

With these essential features properly taken care of, many minor repairs may be postponed or patched in a more or less temporary manner without seriously interfering with the efficiency of the service required of the equipment.

Live Up to Spirit of M. C. B. Rules

Many of the betterments listed above may be made only when the cars pass through the home shops. With the railroads operating as a single system and cars circulating with greater freedom than ever before, the accomplishment of betterment programs may be painfully slow. But immediate results may be attained by a more liberal application of the basic principle of the M. C. B. Rules, as stated in Rule 1: "Each railway company must give to foreign cars while on its line the same care as to inspection, oiling, packing, adjusting brakes and repairs, that it gives to its own cars." As each railroad is compelled to do more and more of its own business with cars other than its own, there should be a strong incentive for a much stricter adherence to the spirit of this rule than has generally been observed.

The M. C. B. rules require the repair of foreign cars in kind, and under these circumstances the original construction of cars cannot be modified, even though the best interests of efficient transportation demand that reinforcements be made. Nothing in the rules requires the haphazard patch-work which the foreign car usually receives, however.

New end sills and draft timbers are frequently applied to wornout draft sills incapable of holding the bolts. Sheathing is patched up on box cars with sills so rotten that they will not hold nails. Frames are allowed to deteriorate until a shifting load encounters no resistance. Such cars are released from one repair track only to return to the next for further patching or because of complete failure of parts which should have been renewed at the outset. Such repairs are an absolute waste of labor and no longer should be tolerated, much less condoned. Although the all-wood car is far from being of ideal construction, a sane policy of making repairs to such cars on foreign lines would effect an increase in transportation efficiency that would go far towards keeping the number of cars out of service for repairs within the four per cent mark set by the Railway War Board.*

The incentive for making adequate repairs of this kind would probably be increased by a revision of the M. C. B. rules to permit the equipment of foreign cars with safety appliance standards. Were it possible to do this work without the necessity of securing authority, time would be available in which to make thorough repairs, and the cars would be returned to service in good condition.

Systematic Lubrication of Journal Boxes

One of the most widely discussed subjects relating to car operation and maintenance is the lubrication of journal boxes. This subject has been investigated and methods of packing studied in the greatest detail, and yet hot journal boxes are still a source of much trouble.

Journal boxes on the foreign car have always received the same kind of attention as the rest of the car, with the notable exception of the air brake equipment. Considerations of safety have led to the practice of periodically cleaning and repairing triple valves and brake cylinders. Indeed, without such a system in force, successful train operation would be extremely difficult. The journal box requires essentially the same treatment and a similar system of periodical attention might well be adopted. Of course, results in this direction can be obtained only by concerted action, and the suggestion recently offered by P. J. Burns, superintendent rolling stock of the Michigan Central, in a paper read before the Central Railway Club, that lubrication be placed squarely under the M. C. B. rules, just as is any other repair, is worthy of serious consideration. Systematic lubrication of journal boxes means not only a reduction in delays and damage caused by hot boxes, but a material reduction in train resistance which will be reflected in the coal bill.

Building Cars In Railway Shops

It has been suggested that cars available for service may be materially increased by the general adoption of a policy on the part of the railroads of building new cars, a few at a time, in connection with the regular repair work. Aside from the difficulty of securing material to advantage in the small quantities which such a policy would require and of producing the equipment economically, few shops have more facilities than are required to take care of the volume of repair work to be handled. With a limited supply of labor as well, the general adoption of such a policy would undoubtedly result in falling behind on the regular repair work. The largest result, measured in output of serviceable cars, will generally be obtained by the use of the available resources in making thorough and periodical repairs to existing equipment. The general adoption of such a building policy would throw into service a large number of wooden cars of a variety of designs, many of which would be ill considered and inadequate to stand up for a reasonable length of time in service, leading to an accumulation of trouble a few months hence.

To effect improvements of the kind outlined, with a shortage in the supply of both labor and material, will not be an easy matter, and undoubtedly ideal results cannot be obtained. It is only in this direction, however, that an increase in the number of cars available for efficient service—on the road and not on the repair track—may be obtained. We are in a war of armies no more than a war of all resources, and maximum efficiency of transportation is essential for the co-ordination of our resources. The success of the nation, therefore, depends no less upon the sacrifice of those who go to the front than upon the supreme efforts of all railroad men to meet the demands on our transportation system, no matter what the obstacles.

* See the *Railway Age Gazette* for May 11, page 1010.

The War's Effect on American Railway Finance

Price at Which Railways Can Obtain New Money or Finance Maturing Obligations Has Been Greatly Advanced

IT is safe to assume that during the war American railroad managements will try to raise, through the sale of securities, only such amounts as are necessary to refund maturing obligations and to pay for additions and betterments to the property which cannot economically be postponed. The high cost and the scarcity of materials and of labor will preclude any very great expenditures on new railroad building or on additional facilities, such as grade reduction, double tracking, large new yards and large new stations, even if money were easily obtainable for these purposes.

The experience of the English railroads in this respect is interesting. Their net returns were guaranteed soon after the outbreak of the war by the government, so that apparently they had virtually the government's credit to draw upon for such capital expenditures as were necessary and approved of by the government. The 11 largest English railway companies estimated that they would need to spend during the first *calendar year,* after the beginning of the war, roughly $30,000,000 on capital account, but actually expended only approximately $20,000,000. Including the smaller companies and the Irish and Scotch railroads, the 44 principal companies of the United Kingdom proposed at the beginning of 1915 to spend $38,000,000 and actually spent less than $25,000,000. Whether or not materials and labor in the United States will become so hard for American railroads to procure as is suggested by the experience of the English railways, it is, of course, impossible to say; but, on the other hand, the American railroad system, taken as a whole, is not in anything like the permanent condition that

the English railroads are. There will have to be a far greater amount of money spent on additions and betterments to property for American railroads than was the case for English railroads. Ours is a still growing system, and with the enormous volume of traffic which it is now handling various parts of it will have to be strengthened materially or expanded.

Both the English and French roads have found that the absolutely necessary renewals of and additions to equipment were on a proportionately much larger scale than the absolutely necessary expenditure for additions and betterments to other railroad property. While current funds will be used in good part to pay maturing equipment trust obligations, if rates are so adjusted as to permit profitable operation of the railroads there will still be required very large sums for additional new equipment.

The American railroads are in a different situation as regards credit than are the English or French roads. American railroad credit has got to stand on its own feet. New railroad capital, either for refunding purposes or for additions and betterments, will have to be raised not with the aid of the government credit but actually in competition with government securities.

For the purposes of this discussion, the possibilities of marketing new issues only of securities by railroad companies will be considered. The effect of the war situation on the quoted prices of already outstanding securities will be discussed only in so far as it has a bearing on the possibilities of the sale of new securities. For the purposes of this discussion, investors, and by this is meant not only those who invest funds permanently, but also those who buy for a "long pull," as it is called, may be divided into three classes. The first class are those who demand security of principal. Of course, there are sub-divisions of this class. The investor who wants absolute security will confine himself to certain government issues of bonds and to some municipal issues. In general, however, it is customary to include in this first class investors who will consider the purchase of bonds which are a legal investment for savings banks in the states of New York and Massachusetts.

The second class includes investors who want to get a considerably higher interest yield on their money than can possibly be secured from bonds which are a legal investment for savings banks in Massachusetts.*

The third class includes those who expect to make either a very high yield or to get a profit through a large advance in the prices of the securities which they buy to be held temporarily. This third class might be called the speculative investing class, and in the United States is very large, indeed.

The general trend of railway regulation has been such that now only the second class of investors can be reached by railroads with new issues of securities. Few of the very strong railroads, even those with some outstanding issues of bonds which are legal investments for savings banks, have open first mortgages under which they can sell any great amount of additional bonds. Railroad regulation has almost entirely shut out railways from the third class of investor. Promoters' profits, speculative railroad building, speculative profits, those things which appeal to the class of investor who is willing to take a very considerable risk in order to make, not a fair interest return, but rather a good sized profit, as profits would be considered in ordinary business, can find little to attract them in railroad security issues.

Before the war railroads still had to some extent a possibility of selling their securities to the second class of investors, those who wanted a higher yield than they could get on government bonds and who have correspondingly less safety of principal. But even before the war new issues of railroad securities had to compete with this class of investor, with public utility issues and some large industrial companies' issues.

W. M. Acworth, the English economist, testifying before the Newlands committee at Washington, gave it as his opinion that a yield of about half of one per cent higher was required on the bond of a strong corporation to make it sell on a par with a strong government issue. Mr. Acworth in making this comparison left out of consideration income taxes, bankers' commissions, etc. These would add probably at least another 1 per cent, so that a bond of a strong corporation would have to be sold on approximately a 5 per cent interest basis to compete with the United States Liberty Loan sold on a 3½ per cent basis. But very few railroads can offer bonds which would come under the class of bonds of a strong corporation which, yielding 5 per cent, would compete with United States government 3½'s.

In other words, the railroads probably will have to make new issues even of bonds attractive to the second class of investors, and this means that they will have to sell bonds on at least as high as a 5½ per cent basis and for the great majority of railroads on a 6 per cent or even more than 6 per cent basis. By this is meant that it will cost the railroad company this year over 6 per cent. The cost of marketing the bonds will be such as to give the investor a little lower yield than this.

It is almost necessary for a number of American railroads not to do their financing for the next decade through the sale of fixed interest bearing bonds if they are to keep a safe margin between fixed charges and income available for fixed charges and dividends. The second class of investors, however, are demanding, in the case of public utility corporations even, preferred stock that will yield 7 per cent at least, and for common stock well over 7 per cent. The war, therefore, has had two important effects on the possibilities of railroad financing. By forcing the return of American railroad securities held abroad it has made it harder for railroads to issue new securities, simply because of the working of the law of supply and demand. Secondly, because it has given the investor an opportunity to subscribe for a bond at 3½ per cent with almost absolute security of principal and the possibility of having this interest rate later increased to 4 or even 4½ per cent, it has almost shut railroads out from the possibility of selling new bond issues to what we have called the first class of investors. And furthermore, by forcing the railroads to go only to the second class of investors it has radically changed the interest rate at which money can be raised by a railroad company.

It used to be customary to accept 5 per cent as the fair return on an investment in railroad bonds and as a fair cost of money to the railroads, although, of course, a great deal of the money raised by the older, stronger companies like the Pennsylvania Railroad, the Illinois Central, the Delaware & Hudson and others, was raised through the sale of bonds at a price which cost the railroad company only about 4 per cent in interest. There is little prospect that the present generation will see money obtainable by railroads at anything near as low a cost as this.

It would seem, therefore, that the old idea that a solvent railroad company which is not very heavily capitalized can at will raise new money at a cost of not over 5 per cent in interest must be abandoned and a new rate which for bonds of the stronger companies would be 5½ to 6 per cent and for bonds of the weaker companies over 6 per cent, and 7 per cent for preferred stock of the stronger companies and 8 per cent or over for stock of the weaker companies, must be accepted as the "fair return" which is necessary to attract capital into new issues of railroad securities.

* Massachusetts and New York are referred to here because the requirements which their laws make for bonds legal for savings banks' funds are especially strict.

THE RAILROADS AND THE LIBERTY LOAN

The Liberty Loan Committee of Railroads, of which president Alfred H. Smith of the New York Central is chairman, is still busily engaged at the headquarters in New York, assembling final returns from the nation-wide canvass for the sale of Liberty bonds to employees on the "instalment plan."

Upon the receipt of complete reports from all companies, a report will be made of results in detail to each one of the participating railroads, but inasmuch as the task of getting exact totals from thousands of employing officers scattered all over the country is a heavy extra load upon busy accounting departments, the final record is far from complete.

Reports to the committee from 100 companies last Wednesday evening showed a total of 218,081 individual subscribers for an aggregate of $18,414,416 of the Liberty bonds, this being an average of $84.43 per capita. The low average indicates the vast proportion of $50 and $100 subscriptions by employees, and the extent to which the railroads' committee carried into effect the prime desire of the government that the bonds should be scattered so far as possible in the hands of small investors, instead of being concentrated in the banks.

Record of Speed and Efficiency

The entire work of making an individual and personal canvass of practically every one of the 1,500,000 railroad employees was carried out by the railroad managements under the central committee's direction within a bare two weeks' time. The speed and efficiency attained in setting the vast transportation machine at work for the government's Liberty Bond issue probably has no counterpart.

The Committee of Railroads resulted from a request of the general Liberty Bond Committee in New York made after the general national campaign was in progress. The officers who accepted the task were: Alfred H. Smith, president of the New York Central Lines, who was elected chairman; Frederick D. Underwood, president of the Erie; W. H. Truesdale, president of the Lackawanna; L. F. Loree, president of the Delaware & Hudson; Henry Walters, chairman of the board of the Atlantic Coast Line; Walker D. Hines, chairman of the board of the Santa Fe; and John B. Dennis of Blair & Co., New York. H. W. Burnham of Chairman Smith's staff was secretary of the committee.

It was immediately decided to ask each American railroad to establish an "instalment-payment plan" and advance the funds necessary to permit employees to buy bonds and pay for them by monthly deductions from the payroll.

The railroads joined simultaneously in aiding the general advertising of the Liberty Loan. Quantities of the bright posters urging patriotic response were displayed in depots, cars and other public places throughout the country. Special mottos were printed in red ink upon dining car menus and upon general railroad stationery generally. Individual circulars with convenient subscription blanks were handed to employees of all classes. At the committee's suggestion employing officers and department heads personally presented the duty of buying war bonds before each member of their various forces. Some companies delegated special speakers to go out over their lines and hold meetings.

All efforts of the committee were concentrated on numbers, rather than amounts, in enlisting bond-buyers, and the $18,414,416 subscribed by 218,081 employees thus far tabulated does not include any of the large subscriptions by railroad companies themselves for blocks of bonds, which aggregate much more than $50,000,000 and show a dozen companies taking from $1,000,000 to $5,000,000. Moreover, a vast number of railroad employees, it was reported to the committee, had taken bonds at the very first call from their own banks, before the railroad canvass was launched, this being particularly the case among officers.

It is estimated that the complete reports will show about 250,000 individual subscribers for an aggregate of $25,000,000.

Vast Number of $50 Subscriptions

In many offices, every member of the force was found to have subscribed for at least one bond, even including the errand boys and porters.

At the Grand Central Terminal, New York, about 150 of the depot attendants, including three-score of the colored "red cap" porters, took bonds, the latter in most cases paying cash which was not taken from savings banks. There were many subscriptions from the forces of car department, including repairers, inspectors, sweepers and even scrubwomen. One car repairer took $1,000 of bonds for cash, and soon returned and bought $900 additional. A Boston train conductor in active service purchased $10,000 of the securities and paid cash.

Railroad treasurers can prove that in many instances the bond money literally was dug out of "the old sock" and put into circulation after a long vacation from any bank teller's drawer, and many a bundle of old greenbacks arrived with a strong odor of camphor moth balls.

Big New Job of Accounting

General adoption of the "installment plan" involves a vast new task of accounting for the railroads' auditors and treasurers, as the subscribers come from all departments and are scattered and are paid in various ways. Deductions must be made at differing intervals, with interest allowances progressing during the period of payments.

One particularly difficult feature yet to be met is the delivery of the bonds to subscribers. As almost all are coupon bonds payable to bearer, it will be necessary for every recipient of a bond to be identified and a safe receipt secured. This would serve to forbid mailing the securities.

New York Central

Reports of Liberty Bond purchases by officers and employees of the New York Central Lines, covering the system east and west, show a total of 29,395 individual subscribers to an aggregate of $2,128,450, being an average of $72.50 per subscriber.

Of this total, the New York Central proper showed 19,246 subscribers for $1,340,750 of the bonds. There were 15,236 purchasers of $50 bonds; 3,816 subscribers took $100 bonds, and the remaining 194 bought bonds of $500 or more.

The New England Roads

The railroads of New England had a Liberty Loan committee of their own working as a sub-committee of the Liberty Loan Committee of New England and in conjunction with president Smith's committee. An important officer from each of the railroads in New England served on the committee and through its work subscriptions were obtained from railroad employees as follows, the report being complete up to Friday noon, June 15:

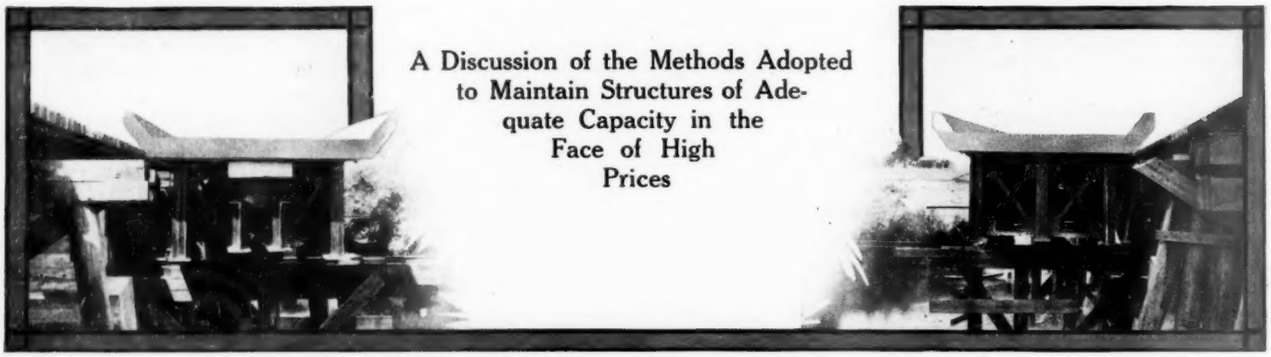
	Approximate number of employees	Number of subscriptions through company	Amount subscribed through company	Amount subscribed through local banks or otherwise
Boston & Maine	29,000	5,772	$297,250	$83,700.00
New York, New Haven & Hartford	44,000	327	26,950	Not stated
Maine Central	6,500	108	27,750	Not stated
Boston & Albany	8,200	860	66,300	Not stated
Bangor & Aroostook	1,800	455	40,550	$7,200.00
Central Vermont	2,600	725	45,000	Not stated
Rutland	2,100	557	42,750	$16,100.00

Buffalo, Rochester & Pittsburgh

On the Buffalo, Rochester & Pittsburgh applications were received from 3,390 employees, the total subscriptions being $275,650. Considerably over 50 per cent of the employees of the company subscribed, with a number of applications coming in too late for acceptance.

Bridge Renewals Under Abnormal Conditions

A Discussion of the Methods Adopted to Maintain Structures of Adequate Capacity in the Face of High Prices



Second-hand Girders Reused with Concrete Floors

CONTRACTS for the fabrication of steel bridges awarded during the last few months have been placed at prices that are two, three or even four times as high as those prevailing during normal times, and, unless premiums have been paid to secure prompt delivery, the dates for the completion of the structures have been set many months into the future.

Normal prices for fabricated bridge work which varied from less than two cents to not over three cents per pound are to be contrasted with current prices that range from 4 to 7 cents, or more, depending on the character of the work, the delivery stipulations and the mill arrangements of the fabricator. The cost of the substructures and the expense for erecting the steel are also appreciably higher than formerly, largely because of a scarcity of labor, but it is the high cost of the plain steel entering the fabricating shop that is responsible for the major part of the increase in the cost of any betterment program, involving the construction of steel bridges.

In the face of this condition there has never been a time in the history of American railroads when there was a greater need for bridges of adequate capacity. With a volume of traffic far in excess of any previous period and with prospects of exacting requirements by the government, it becomes imperative that all obstacles to the movement of traffic be reduced to a minimum. Restrictions on power or other heavy equipment, or resort to slow orders because of weak bridges, become especially burdensome, while a bridge failure with its possibilities of a deplorable loss of life would be even more than usually serious because of the hazard of a military embarrassment which can easily be caused by an interruption to traffic. The destruction of 100 miles of railroad track can be made good in a few weeks' time, while a span lost from a Mississippi river bridge may easily delay traffic for two months or more.

It is for such reasons that while a state of war constitutes a condition of emergency, it does not permit of any departure from established standards of safety in railway operation. This has been well expressed by W. L. Park, vice-president of the Illinois Central, in an address before the International Association of Railway Special Agents and Police. "An expert examination should be made of all roadways and structures over which movements would be likely to take place to ascertain their condition as to strength and capacity. If too weak or of insufficient capacity, steps for remedying the deficiency should be recommended. The whole outcome of the defensive movement might be reversed by inability to transport some heavy guns across a bridge too weak to permit their passage. . . . . "

Nor is assurance of adequate strength the only requisite. Maintenance should not be neglected. Bridges are expensive items of a railway property and the failure to maintain them results in a shortening of life that cannot be restored by subsequent expenditures. Inspection is an essential feature of bridge maintenance. Through it, the need of repairs or other maintenance work is determined and it is necessary also as a safety precaution. While properly designed and constructed bridges rarely develop weaknesses in workmanship, certain faults may arise which require attention and once discovered they should be promptly corrected.

Painting is now costly both as to material and labor but the repainting of a bridge now, before the old coat is destroyed, will not be nearly as expensive as it will be later, when there must be added to the cost of the paint and the labor of its application, the greater cost of removing an

Bridges Must Be Adequate

WEAK bridges present serious obstacles to the movement of heavy traffic.

Difficult and extensive reconstruction may cause more delay to trains than slow orders or loading restrictions.

Owing to the enormous demands made on the steel industry the construction of new steel bridges is expensive and slow.

New work may be avoided in a variety of ways.

The structure may be reinforced by additional members or intermediate supports.

It may be replaced by second hand spans doubled up to give the required strength.

Temporary construction may be used.

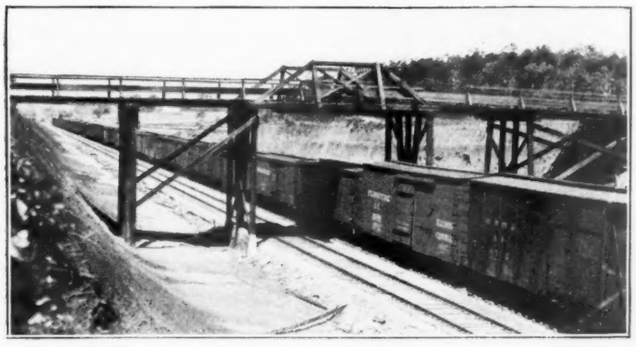
Old double track spans may serve in single track locations.

accumulation of rust. The metal lost in the meantime by corrosion can never be replaced. Since painting is done primarily for purposes of protection rather than appearance, this same consideration holds with nearly equal force in regard to other railway structures.

The Present Situation

Under these circumstances it becomes highly important to study the condition of the bridges on American railways as they are today and to consider what steps must be taken to correct any deficiencies. There is only a remote possibility that military requirements will call for the construction of bridges of any considerable length and of permanent character during the course of the war. Instead, bridge construction will be restricted very largely to the renewal of existing structures that require it because of the increased weights of locomotives and other equipment.

While the replacement of bridges because of inadequacy has been a gradual and continual process, it was accelerated from about 1895 to about 1910, following the rapid change in the character of American locomotives which took place during the late nineties and the first few years of the new century. Locomotives have continued to increase in size, but owing to the general adoption of Cooper standard



Timber Highway Viaduct on the Southern

E-50 train loading for design about 1900, bridges built since that date have been generally of adequate strength to carry safely the largest locomotives built up to the present time. The bridges replaced in the last decade have been for the most part structures built previous to 1900, and as these are growing fewer in number the carrying capacity of main line railway bridges in this country offer a much larger margin of safety than they did 10 or 15 years ago.

In consequence the renewals with which the railroads must contend at the present time are of the current progressive character, such as will be encountered in the structures of any growing industrial activity. In consequence they are not influenced by the present crisis, barring such special requirements as may arise from unusual routings or the interchange of equipment that may be included in the plans of the Railroads' War Board.

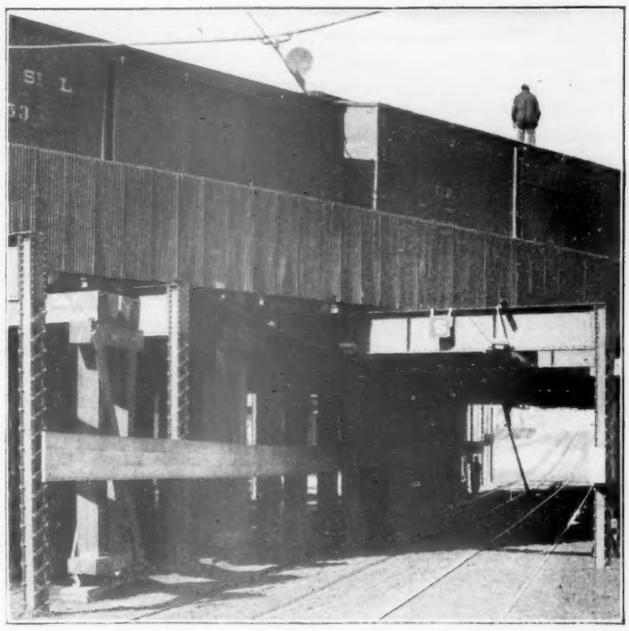
The Problem

The problem imposed is, therefore, the proper disposition of current renewals in the face of the high prices and under pressure of congested industrial activities. A canvass of a number of representative railroads discloses the fact that these conditions have resulted in the postponement of renewals in many cases where this can be done with entire security, or in resorting to reinforcing or the use of second hand structures or temporary construction. It is patent, however, that the present high price of steel does not afford a valid reason for the deferring of permanent work unless a feasible alternative of unquestioned safety suggests itself.

In the consideration of what should be done with any structure, the initial step is the determination of the relation between the carrying capacity of the bridge and the loads to which it is subjected. Unfortunately, a wide diversity of opinion exists as to the character of investigation required. Some engineers resort to detailed stress analyses, while others depend upon approximate calculations combined with a study of any individual evidences of distress on the part of the various members of the structure. Because of this difference of opinion a like disagreement exists as to the allowable limits of overstress. Without entering into the merits of this controversy, it may be said that the thorough analysis affords opportunity for material economy, since it is obvious that the more accurately the actual stresses are determined, the greater is the proportion of the total capacity of the structure that can be developed with safety.

Having concluded that the existing or contemplated trainloads constitute an undue overload on the structure, several plans present themselves for the disposition of the situation. The bridge may be replaced by a new one of similar design, or a modified layout may be adopted which will require less steel or permit the use of concrete or some other substitute material. In the case of a viaduct the substitution of an earth embankment may offer a solution. In some cases it may be possible to strengthen or reinforce the bridge or to replace it by second-hand structural steel doubled up to afford adequate strength. In other cases it may be legitimate to resort to temporary construction and occasionally it may be possible to carry the structure over for some time by restrictions on its use.

Under normal conditions on main lines and with ade-



Subway Bridge Reinforced by Posts and Stringers

quate funds available, the solution almost invariably calls for a new structure, and even at the present time there are many situations offering only the alternatives of a new bridge or the postponement of reconstruction through loading restrictions. To illustrate: a small road in the middle west has a bridge over an important river of which all spans except three have a strength equivalent to that of spans designed to carry Cooper's E-45 loading or better. The purchase of heavier power is contemplated, but these three spans, already overstressed by present equipment, cannot carry the proposed loading with safety. The river is deep,

precluding the use of temporary intermediate supports, and the superstructure, being of the through type, does not allow reinforcing trusses, while an investigation discloses no opportunity for adequate reinforcement of individual members. Thus the case clearly calls for new spans which the road unfortunately is not in a position to buy. Consequently it must forego the advantages which would accrue from the use of larger locomotives on the portion of the line where this bridge is situated.

Modified Design

A less difficult situation might permit the introduction of intermediate piers and the use of shorter spans which would require less steel. There is a common rule that the most economical bridge is secured when the costs of the substructure and the superstructure are approximately equal. With a pronounced advance in the unit cost of superstructure material, it is evident that studies made at this time will give results differing widely from those obtained when the original bridge was built. Several bridge engineers report material advantages for designs involving the use of shorter spans than would ordinarily be considered economical.

The wide use of concrete for all manner of structures suggests the possible substitution of this material in cases where steel has been used in the past. However, inquiry of a number of roads fails to disclose any appreciable change in practice. The railroads that have used concrete extensively in the past find that estimates for structures of relatively greater span now show definite economies for concrete, but they have in most cases hesitated to resort to any marked innovations. For instance, one bridge engineer estimates that concrete girders of 40 and 50-ft. spans are more economical at the present time than steel, but he does not feel that it is advisable to go to this extreme at present. However, another railroad is now building a reinforced concrete bowstring span in place of a through girder bridge. By way of contrast a number of railroads that have been extremely loath to use reinforced concrete in the past are still adhering to their conservative attitude regarding this material.

Methods of Reinforcing Spans

Whenever it becomes paramount to avoid the renewal of a bridge the first consideration is to determine what measures, if any, can be taken to strengthen the structure. The simplest and most frequently practiced procedure is to introduce an intermediate support, or several of them, thereby reducing the span lengths of the superstructure. Pile or frame bents are commonly used for this purpose and, barring cases of excessive height or where obstruction to the flow of water caused by the large number of supports would be objectionable or dangerous, it is a safe and conservative practice, provided that the work is properly designed and constructed and that adequate inspection is given to insure a proper condition of the more or less temporary structure. An important consideration is that the superstructure is adequately equipped to transmit its load at intermediate points. In girders this may involve the addition of some properly designed bearing stiffeners; in steel truss spans some members may require strengthening because of the reversal of stresses taking place near the new points of support.

Another consideration is the strengthening of the superstructure itself. When main members are of insufficient section, it is not often that adequate additions can be made. It is generally considered impracticable to add cover plates to girders and it is only occasionally that trusses can be improved in this way. On the other hand, it is a common experience that many old structures are found to be inadequate at the present time, not because of insufficient sections in the main members, but because modern designing practice applied in the investigation of these old bridges discloses a lack of balance in the design or weaknesses in details—weaknesses so pronounced that they call for restrictions on the bridge loading. Where this is the case it is frequently possible to correct the faulty details and continue the structure in use. Among details commonly found at fault on girders are inadequate flange riveting, insufficient web splices and poorly arranged bearing stiffeners. In truss spans the more common faults include inadequate pins and pin plates and eccentricity of compression members, while the floor systems suffer from the same shortcomings encountered in girder spans. Various schemes have been devised for overcoming these difficulties with a display of more or less ingenuity. The Chicago, Milwaukee & St. Paul once replaced a number of pins in a swing bridge successfully by driving larger ones into reamed holes.

Long span bridges are to a certain extent in a class by themselves. Owing to the fact that the weight of the span itself in such cases forms such a large proportion of the total load, pronounced increases in the train loading exert only minor influence on the total stresses in the truss members. The service life of such structures can frequently be lengthened appreciably by strengthening floor systems, subpanel members and other parts that are more directly effected by variations in the live load. This idea was put into practice only a short time ago on the cantilever bridge of the Frisco over the Mississippi river at Memphis. Similar strengthening measures were taken on the Illinois Central bridge over the Ohio at Cairo, Ill.

If the strengthening of individual members of details of the span will not suffice it may be possible to add other members to the superstructure. Deck truss spans are most readily reinforced in this manner, since a third truss can be introduced between the two existing trusses without much difficulty. A number of steel viaducts throughout the country have been reinforced in this manner. Through girder and truss spans obviously cannot be strengthened this way and even with deck girders the work is not readily carried out as a reinforcing project but must really be considered under the head of reconstruction. The adding of the center truss in a deck span may also lead to difficulty in the case of a double track bridge. Instances have come to notice where the great difference in stiffness of the side and center trusses when subjected to loading on one track only has resulted in such increased deflection of the weaker outside truss as to produce serious racking of the entire structure.

The Re-Use of Old Spans

Second-hand bridge spans are seldom available unless they have been released because of inadequate strength. Consequently their re-use without alterations is restricted largely to branch lines subjected to lighter loading. This re-use on inferior lines is an accepted practice. An erection superintendent who has had nearly 40 years of experience with a large road running northwest from Chicago, has dismantled and re-erected some spans on that road as many as four times, transferring the structures each time to lines of less importance. Another use made of this old steel is in highway bridges and viaducts. Both the Chicago, Milwaukee & St. Paul and the Chicago, Burlington & Quincy have highway viaducts over large classification yards at Chicago, made up of old spans taken from Mississippi river bridges.

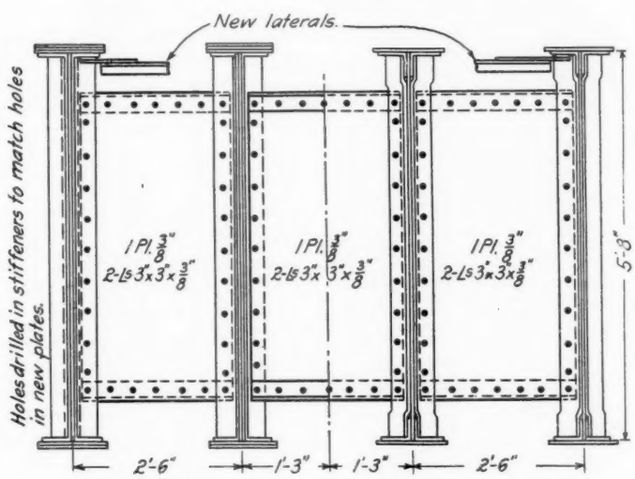
Old spans from double track bridges are frequently put to more advantageous use, but it is only in recent years that any number of these have become available for such substitution. By remodeling the double track spans into single track structures it is frequently possible to secure adequate carrying capacity for main track use. Thus the Union Pacific has planned to re-use the four 250-ft. spans recently released from its Missouri river bridge at Omaha. By providing new lateral and floor systems, single track

spans of virtually full standard loading will be available.

Doubling up, or using two spans to make one, has been applied to a limited extent with deck truss bridges. It has also been done occasionally with old through pin-connected spans having the floor beams suspended from hangers. This, however, is entirely out of the question under present day structural details. Deck bridges offer the most promising field for the substitution of old steel because of the ease with which the trusses and girders may be doubled up. In the case of trusses it is usually a matter of the reinforcement of an existing structure as mentioned previously, but in the case of girders the more practicable plan is to introduce the complete newly reinforced span. This can be done by the use of either three or four old girders supplied with new lateral and sway bracing to make them act together.

The simplest case is that presented by the use of four duplicate girders. The detailing of the new connection steel is simple and unity of action is insured by the fact that all girders have equal strength and stiffness. The next case in order is the use of three like girder spans to produce two spans of three girders each. The detailing is not difficult and the remarks above apply to the action of such spans under load.

It has been found entirely feasible to use combinations of girders differing not only as to details, but with small



Typical Section of a Remodeled Girder Span

variations as to length and depth. In this connection, the Chicago, Milwaukee & St. Paul has found the concrete ballast floor of great assistance. Even girders from through bridges with curved ends have been utilized, since all variations in the top surface can be adjusted by varying the thickness of the concrete slab. This eliminates all the complicated sizing and dapping of ties to allow for various thicknesses of cover plates, the presence of rivet heads, etc. Where the tops of the girders present such irregular surfaces it is not practicable as a rule to build the concrete slabs as units to be set after the girders are in final position. Instead they are poured into forms built on top of the assembled spans, a procedure which ordinarily implies the erection of the girders along side the existing bridge, with provision for rolling them into place when the old structure is removed. The addition of a ballast floor results in a material reduction in the live load capacity of the girders, but by a proper combination an excess of strength is usually secured.

The doubling up of old girders should always be accompanied by a thorough overhauling of the old steel. Aside from the replacing of the defective rivets, an analysis frequently will demonstrate the need of strengthening certain details. Such work can ordinarily be done very well by the field force when the spans are erected, but occasionally such alterations may assume proportions that will make it more economical to have the changes made at a bridge shop in spite of the transportation charges that this will involve. As an illustration of the economies of this form of construction an account is given below of a structure of this kind recently erected on the Rock Island.

60-Ft. Deck Plate Girder Span Remodeled

The span was made from two second-hand spans built in 1886 and designed for two 85½-ton locomotives. Each span weighed 38,476 lb. They were removed from the main line upon the introduction of heavier power equivalent to a Cooper's E-55 classification, while the old spans rated but E-45 at a maximum unit stress of 22,000 lb. per sq. in. on the net section. After the work of remodeling was completed, the total weight of the span was as follows:

Four girders	69,336 lb.
New material	4,332 lb.
Miscellaneous second-hand material	3,603 lb.
Total	77,271 lb.

The field work consisted of cutting the old spans apart, as they were riveted up complete on removal from the former location. This involved removing the old laterals, lateral plates and cross-frames. New material for diaphragms and lateral plates was ordered from the bridge company, while the lateral angles and stiffening angles for the diaphragms were cut from the old laterals and cross-frames. The entire field labor necessitated cutting out 560 shop rivets, drilling 600 holes, making 144 angle cuts and driving 1,270 field rivets. The actual cost of this field labor was $262, and the work was done by the regular bridge-erection crew.

With steel at $50 per ton and assuming second-hand girders to be worth $20 per ton, the cost of a new 60-ft. deck-plate girder span, designed for E-55 loading, according to the American Railway Engineering Association specifications for stress and impact, would be approximately $1,500, while that of the remodeled span may be figured as follows:

Second-hand material, 36.5 tons, at $20	$730
New material, 2.2 tons, at $60	132
Field labor	262
Total	$1,124

The remodeled span, providing the steel is in fair condition, will carry as heavy ultimate loads as a new span, and it costs less with a fair valuation of second-hand material.

Temporary Structures

The wide divergence between the prices of steel and timber prevailing during the last year has resulted in a pronounced return to timber for railway structures. As a typical case, the Northern Pacific recently constructed a pile-trestle at a location where the use of four 75-ft. girder spans had been under consideration. Estimates demonstrated that the trestle could be renewed at intervals of 18 months for the amount of money required to build and prepetuate a steel bridge at present prices.

It is interesting to note that the pile trestle was built in 24-ft. panels. The Burlington recently resorted to a similar design for 700 ft. of trestle in its new bridge over the Platte river near Yutan, Nebr. The bents are spaced 20 ft. center to center with stringers 9 in. by 24 in. in section. The long spans made possible by the use of such large timbers, materially reduce the waterway obstruction, thus tending to remove one of the objections to the pile trestle in waterways having appreciable current; railroads tributary to the Douglas fir country are generally taking advantage of the large sized timbers available in this wood.

Howe truss spans have been much more common in the northwest than in other parts of the country in late years. Under stress of the existing high prices of other materials it is not strange that they are being built at the present time. The Southern Pacific recently rebuilt three of these timber spans to postpone the purchase of 750 tons of steel.

One of the photographs shows a creosoted timber highway over-crossing of a type used by the Southern on double track work because of the delays in delivery of steel spans. These structures afford a 20-ft. clear roadway and provide a 33-ft. clear span and 22-ft. overhead clearance and cost an average of $2,000 each. It has been found practicable to adopt this type of structure for skews as great as 45 deg.

In any plans for the use of timber, the need of preservation as a means of securing the maximum life and therefore the fullest benefit of the investment in the timber structure is obvious. There are few cases where it does not pay to treat the timber structure as a permanent one rather than as a temporary makeshift.

Carrying the Structure Over

Under the present need for the use of the railways to their fullest capacity, the last resort in the study of any structure is the deferring of construction or reconstruction by restrictions on the traffic. However, as cases will arise where this procedure must be taken under serious consideration, a review of current practice under this head is in order. Obviously if a bridge cannot be rebuilt or strengthened measures must be taken to restrict the loading. For example, the double-heading of locomotives over the bridge can be prohibited or certain large locomotives may be ruled off entirely. One measure that has been of definite advantage in such cases is the slow order. Where assurance can be given that restrictions on speed will be complied with the use of the slow order is entirely legitimate. Impact tests on bridges have resulted in the accumulation of a considerable amount of definite information as to the influence of impact upon stresses, from which it is clear that reductions in speed to 10 miles an hour or less will effect reductions in the total stress just as definite as reductions in the actual live loading. In such cases too much emphasis cannot be placed on the need of careful stress analysis. Actual stress determination in the field with instruments may also be justified in some cases.

Another means of reducing the loading, applicable only to bridges built for double track, is to restrict the operation to a single track or gauntlet tracks. This was done for a number of years on the old Union Pacific bridge at Omaha. Plans for the reconstruction of the Poughkeepsie bridge over the Hudson river provide for alterations of the floor system that will permit the use of this bridge by heavier locomotives operating on single track, whereas the structure has been used for double track ever since its construction. The practicability of these various plans for traffic restriction depend upon the operating conditions and must be considered in that light, taking into account the effect of possible enormous increases in traffic on certain lines which may be brought about through the movement of military trains. In the case of restrictions on single track operation on a double track bridge, changes in operating arrangements such as a great increase in the trainload may make double tracking entirely unnecessary.

Conclusion

In war the defeat of the foe calls for the application to the fullest measure of the most effective methods of warfare, developed in the conduct of actual hostilities. It is futile to suppose that the necessity of the moment will bring forth new forms of combat so ingenious or overwhelming that their use will obviate the need of a maximum prosecution of the established methods which involve an expenditure of life and property terrible to contemplate. All problems encountered must be attacked with resources and knowledge well in hand. This applies with equal force to associated activities. The operation and maintenance of the railways under stress of the war will be conducted by methods differing only in minor details from those in common use. Similarly the reconstruction of bridges at this time calls for the application of only such methods as have proven thoroughly effective, entirely safe and reasonably economical in the past. In consequence the problem of providing railroad bridges of adequate capacity for the demands of traffic requires nothing more than the intelligent use of methods developed in the past for the reconstruction, strengthening and repair of bridges, the use of old spans in place of new for temporary construction along the lines outlined on previous pages. Each situation demands its individual solution and American ingenuity in the adaptation or modification of well known methods will assert itself as in the past. The demand for continuity of railroad service, always important, now becomes paramount and restrictions imposed by the requirements of uninterrupted traffic in normal times now becomes imperative. Under such circumstances programs for wholesale reconstruction, unless absolutely unavoidable, are ill advised.

STATE COMMISSIONS PROMISE CO-OPERATION IN HEAVY LOADING CAMPAIGN

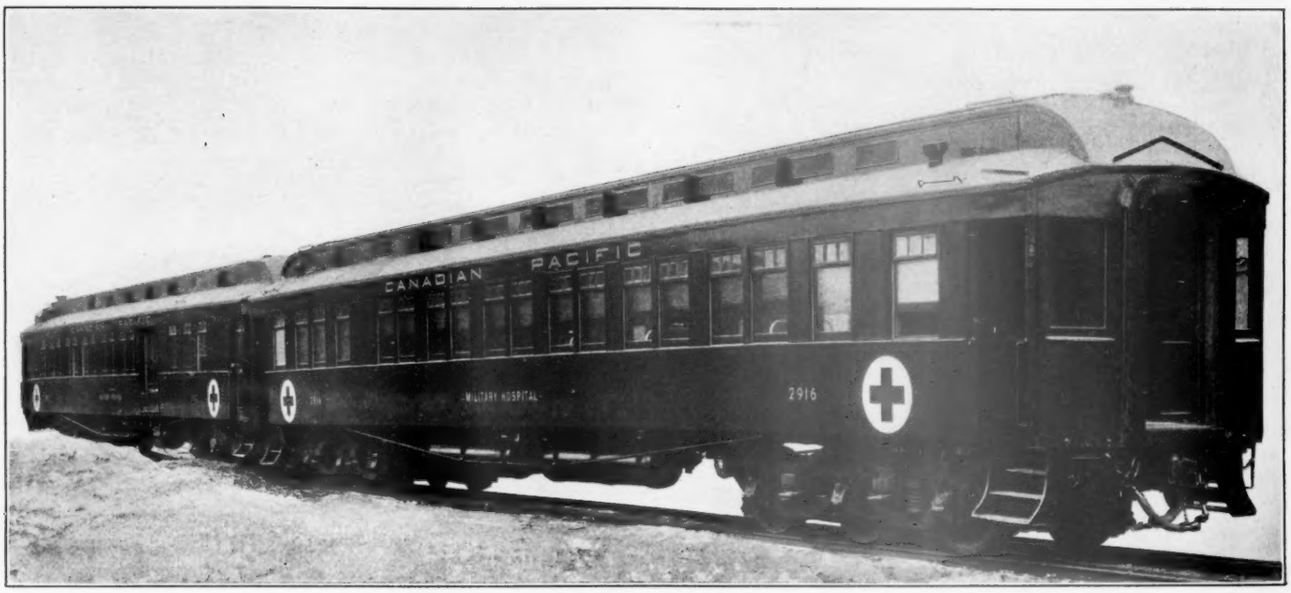
The Railroad War Board has recently addressed to each state railroad commission the following letter, urging the importance of securing a heavier average loading of freight cars:

"The Commission on Car Service, a sub-committee of the Special Committee on National Defense of the American Railway Association, desires to call your attention to the necessity for co-operating between all interests, in order to obtain full efficiency of the transportation unit, or freight car, and asks your unqualified support in connection with the demand upon the shipping public to disregard established trade units and minimum car-load weights, and instead load all equipment furnished to the full cubical or carrying capacity, and by this method avoid loss of 20 per cent to 25 per cent efficiency, which now prevails; thus assisting in relieving congestion, and at the same time making more cars available for handling the traffic offered, both for the government and the general shipping public.

"Many terminal yards and industrial tracks are now taxed beyond their limits and they cannot be enlarged or extended to a material degree; but these tracks will be relieved if equipment is loaded to full capacity. This will materially increase the total tonnage handled, with better and more regular service."

Replies promising support have been received to date from the commissions of Alabama, Nevada, Montana, Minnesota, Maryland, Maine, Louisiana, Arkansas, New Mexico, Oklahoma, Virginia, Wisconsin, Tennessee and Missouri.

Railroads Not Opposing Taxes.—Samuel Rea, president of the Pennsylvania Railroad, has issued the following statement in regard to the hearings before the Senate Finance Committee on the war revenue bill. "The railroads are not protesting against any tax. Like other business men, we are in Washington inquiring what the proposed taxes are to be, and to help so far as we can in making suggestions that will insure proper taxes for the government, and yet taxes that will allow the railroads and every other business not only to exist, but to expand. The Senate and House of Representatives have the full sympathy of the railroads in trying to frame a tax measure. It is one of the most arduous tasks they have in hand, and so far as the railroads can help they will do everything in their power."



A Unit of the Canadian Pacific Ambulance Train

Ambulance Trains from Civil War to Present

The United States Originated These Hospitals on Wheels in 1863 and Used Them Very Effectively

WE are rather fond of chiding ourselves because after having invented the aeroplane and the submarine, we let others out-distance us considerably in perfecting them. But there is another instrument that we originated for use in warfare as to which, thanks to our efficient railways, we have not been nor do we ever expect to be outclassed. That is the ambulance train, introduced to the world in our Civil War and first used in 1863 on the Orange & Alexandria, now a part of the Southern Railway, to carry wounded to the base hospitals.

It is a question as to which deserves the greater emphasis, the fact that America was the first to use the ambulance train or the fact that in the war the Union forces had a foe who respected the hospital trains for what they were, namely, instruments of mercy for the alleviation of human suffering. Up to the time the Kaiser's cohorts took the lists, respect for hospital trains or ships would have been taken for granted. The German semi-official announcement one month ago ships in the entire barred ment in the future, will prevent all traffic by hospital ships in the entire barred zone and will regard hospital ships appearing therein as war vessels and attack them immediately." In our Civil War the Confederates were under orders not to molest hospital trains and it is on record that, orders or not, the trains were let absolutely alone.

Napoleon is said to have remarked that, as a rule, a dead soldier was to be preferred to a wounded one. Fighting has changed considerably since the great emperor's day, but in few ways has it changed more than in the care and successful treatment of the sick and wounded. Now nearly 75 per cent of all the wounded are able to return to the front as efficient soldiers. And no small part of the credit will be paid by medical officers to the ambulance trains that carry the temporary cripples to the base hospitals, where, away from the rush and bustle of the front, the men are able to rest in greater quiet and receive more careful and considerate attention. Transportation carries the soldiers and their instruments of destruction to war, but there are few other elements that do both that and serve as agencies for alleviation of suffering.

It is a tender subject to touch upon, but the American railways and the American people are now at that point where they must face the fact that America will soon be using ambulance trains again. Where they will be using them and how they will be using them does not yet appear. But, possibly we shall have to send hospital trains to France to carry our own

Hospitals on Wheels

NAPOLEON said a dead soldier was to be preferred to a wounded one.

This was before medical science had reached anything like its present efficiency, and before ambulance trains were used to carry the wounded away from the scene of action.

The first hospital train was run on the Orange & Alexandria (now part of the Southern) in 1863.

Such trains attained a high state of efficiency in the Civil War.

They are being extensively used today on all the European fronts.

The trains used in England, France and Canada have features that deserve adoption in United States.

wounded soldiers from the fighting fronts to the seaports as England has done. Certainly, we shall have to operate ambulance trains from our own Atlantic ports to hospitals in the interior cities, as Canada has done.

America's Opportunity to Develop Ambulance Train Service

As America girds itself for its entrance into the present tremendous struggle for the well-being of mankind, it has an advantage far greater than most of its citizens realize, in that it has had time to organize, while its allies keep the Teutonic wolf from jumping at its throat. And this chance to obtain a firmer grip upon its weapons and to put on its armor is shown in great degree in connection with the ambulance service. In every war, the first consideration on the outbreak of hostilities is mobilization and organization for supplying the armies in the field. The ambulance service is always secondary, and waits until the first onrush of the opposing armies has settled down to an enduring campaign. This was the case in France. It was the case in our Civil War. There was a different condition, however, in the Civil War in that the American military men and railway officers had no examples to follow, that war being the first in which railways had been used to any great extent to assist an army in the field. In the Italian war of 1859 the French and Austrians had merely carried the seriously wounded laid on straw in freight or cattle cars and the less seriously injured in ordinary third class cars, under conditions, surely, that must have been little less than frightful.

Naturally, the means for caring for wounded in the first few months of the Civil War were very haphazard, but as time went on an organization was perfected that was able to do remarkably efficient work. After the battle of Chancellorsville over 9,000 wounded were carried over the single track Aquia Creek Railroad from Aquia Creek to Washington between the morning of June 12 and the evening of June 14. In the 20 days following the battle of Gettysburg over 15,000 wounded were distributed to hospitals at Harrisburg, Philadelphia, New York and Washington. These figures do not look big today, but they bespeak a remarkable advance over what had been done before.

In the first part of the Civil War, the less seriously wounded were carried sitting up in ordinary passenger coaches. Those too injured to sit up were left on the stretchers or mattresses in which they had been placed in the hospital and stretchers and all were lifted into box cars and laid on straw or hay, or perhaps on pine boughs or leaves. At first, ordinary box cars were used, holes being cut in the sides for light and ventilation. When the cars arrived at Philadelphia, New York, Washington, or whatever city it might be, the patients were lifted out and carried to the hospitals, still on the original stretchers. This scheme had the drawback that only 10 men could be cared for properly in one car; 20 wounded were often carried, but with great inconvenience.

Early American Hospital Cars

Soon cars with two or three tiers of rough wooden bunks along each side were introduced. In March, 1863, cars were placed in service in which stretchers were suspended from pegs on uprights by means of strong india rubber rings, but this idea never attained success because the patients did not feel secure on such springy cots. Great difficulty was found also in keeping the stretchers from knocking against the uprights. The attempt was made to use the same stretcher from field hospital to the base, but this also met with considerable difficulty because the stretchers varied so in size and shape. Various other cars were introduced from time to time as the war progressed, among the noteworthy examples being one first used late in 1862 on the Philadelphia, Wilmington & Baltimore. This car held 51 patients and was provided with a stove, a water tank, a locker and a seat for attendant, and was used with the many others patterned after it to carry patients to Baltimore, Harrisburg, Philadelphia and New York. The cars moved in regular trains and not in ambulance train units. Similar cars containing 24 beds in two tiers, the lower tiers being fixed on the car seats, were used by the Army of the Cumberland.

Much discussion has arisen as to the first ambulance train. Evidence seems to show that honor should be given to the Medical Director of the Department of Washington, who in 1863 ordered the construction of a number of complete trains which were soon put in service on the Orange & Alexandria (now part of the Southern Railway) and used to carry wounded to the base hospitals at Washington and Alexandria. These trains had special cars for the surgeon and his staff, for the apothecary and storeroom, for the kitchen, etc., and ten ward cars, each of the latter accommodating 30 lying-down and 20 or 30 seated patients. There was thus a capacity of from 500 to 600 patients to a train, which compares exceedingly well with the trains now being used in France.

Similar trains were soon put in service in the west, three being used to carry wounded from Atlanta to Louisville, a distance of 472 miles. These trains were of high grade equipment, many of the cars being specially built, and were put in the hands of careful crews. Each train consisted of ten cars, there being five ward cars for lying-down patients, a surgeon's car for the doctor and his staff, an apothecary car, an ordinary passenger car for sitting-up patients, a kitchen car containing also the dining room and storeroom and a car for the crew. Passenger cars were converted to provide this equipment. Thus, in the ward cars, two of the windows and the accompanying panels on each side were removed and replaced by a sliding door. Through this doorway stretchers could be carried much more easily than through the end doors. The three trains ran on a regular schedule each taking one section of the route, going up one day and down the next. Sometimes men were carried through the 472 miles directly, the ward cars being transferred from one train to the other. The more usual method was to empty partially the hospitals at Nashville and Chattanooga and to bring up other wounded who would not be injured by moving.

The trains attracted some very favorable comment. One medical officer reported concerning them: "In visiting these hospital trains, the air is found sweet and pure, the wards are neat and inviting; and it may unhesitatingly be said that men on hospital trains are often as comfortable and better fed and attended than in many permanent hospitals."

The Army of the Potomac also had similar trains of 12 cars, including one for the surgeon and his staff, another for the kitchen and dispensary and 10 ward cars for sick and wounded.

Confederate Regard for Ambulance Trains

Some very interesting stories are told relative to the careful consideration given the hospital trains by the Confederates and the record is quite different from that of our present adversary in Central Europe.

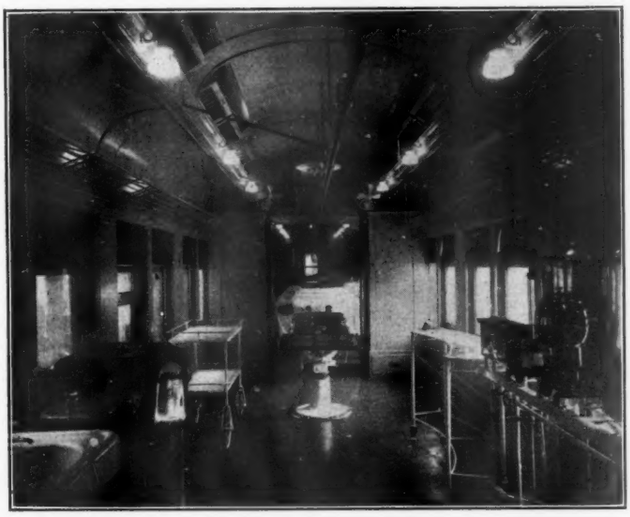
The locomotive stacks were painted a brilliant scarlet and the exterior of the hood and tender were of the same color with gilt ornamentation. At night three red lanterns were hung in a row under the headlight. These distinguishing features were recognized by the Confederates, and the trains were never fired upon or molested in any way. One surgeon was informed by wounded Confederate officers in Nashville, who were captured at the battle near that place, of the stringent orders of General N. B. Forrest for the non-interference with and protection of the hospital trains by giving them timely warning in the event of the railway being obstructed or torn up. The troops of Col. John Morgan's com-

mand had similar instruction. It is recorded that on one occasion this officer's scouts stopped a train, put it on a siding, and after inquiring if there were sufficient stores upon the train, they tore up the track and captured and destroyed five supply trains that came through before the alarm could be given.

Ambulance trains were extensively used in the Franco-Prussian War and, of course, they have been gradually reaching higher standards in each successive war. The South African War, in particular, was characterized by high grade hospital train development.

Ambulance Trains in France

At the outbreak of hostilities in the present war, the French were so hard pressed that they found it impossible to care properly for their wounded. There were actually only seven ambulance trains in readiness and so fast did the Germans advance that no organization could be perfected to improvise additional ones. An American doctor, writing about his own experiences, said that even in September, 1914, "the French management of wounded trains is so shocking that it can hardly be spoken of. Men are crowded into box cars where they lie about on the floor, dead and living together, for three or four days in filth that is beyond description."



Photograph from Press Illustrating Service, Inc., N. Y.

Car Prepared for the Maryland Preparedness and Survey Commission. Note the Overhead Conveyor. This Car Runs with Two Ward Cars

In fact, those wounded men were lucky who were put upon a train at all.

Gradually, this condition of chaos was remedied, and a very efficient system of railway transportation of the wounded was worked out, so that by the middle of 1915 over 250 hospital trains were in the service of the French authorities.

The *Railway Age Gazette's* European correspondent has already described the French ambulance train organization in the issue of October 8, 1915, page 639. The hospital trains, he said, were divided into three classes, permanent, for the badly wounded; semi-permanent, for lying-down cases not considered very serious, and improvised, for wounded who can sit up.

The wounded soldiers are brought back from the front in motor ambulances to evacuation stations. Here they are tagged according to the gravity of their condition, a white card for a slight wound, a red for a serious wound and a blue for a wound of medium gravity. Each wounded man is provided with a paper stating his condition, his company, his name, and the place where he was wounded and is directed with his effects toward a general distribution railroad center. This intermediate transportation is made either by train, by automobile ambulance or by hospital canal boat, according to circumstances. There are 19 of these great railway distribution centers placed at intervals all over France, the total governed by nine divisional stations, which are in turn governed by the seventh direction of the Minister of War. The 19 distribution centers discharge their wounded in 18 regions, one or more centers to a region.

Arrived in one of the 18 regions, the wounded are then distributed according to their wounds in hospitals specially adapted for their treatment. Those seriously wounded about the body are sent to practically any general hospital, but those suffering from nervous shocks or eye wounds are generally directed to Paris, where the largest number of special hospitals are located. Those who are suffering from typhoid fever are likely to be sent to the watering places, like Vichy or Biarritz. This division of regions into centers of special treatment forms one of the most complicated and interesting details of the whole method of transporting the wounded.

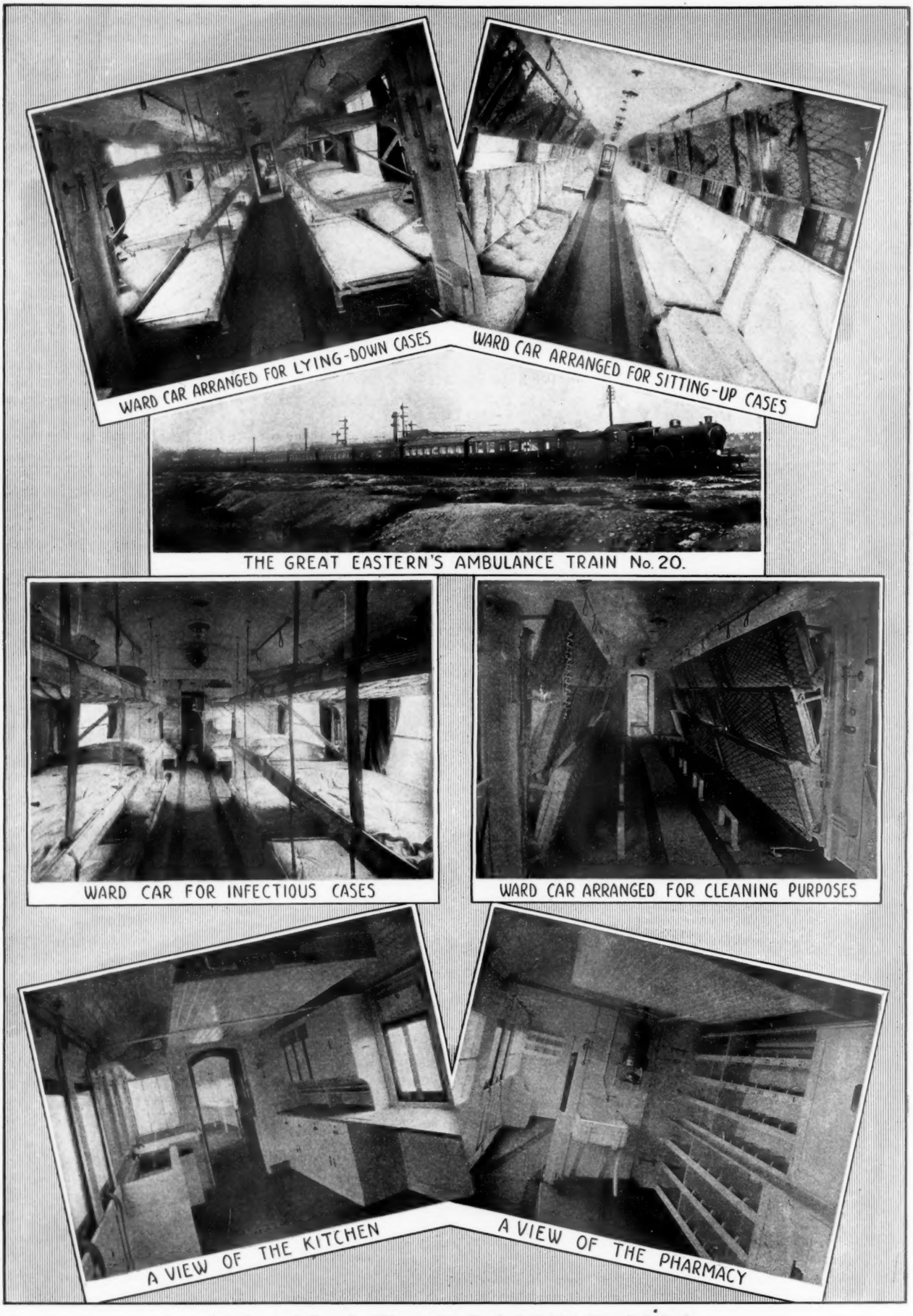
There are special railroad experts detailed at the office of the seventh direction of the Minister of War who keep in touch with every hospital car and train in France, just as a chief train despatcher does with his freight and passenger trains. Every morning these experts receive reports showing the position of trains unloading in the various regions and indicate the trains needed at the front. When a battle is being prepared for at one or more points along the front, they make their preparations just as does the chief surgeon of the army corps involved. These railroad experts, taken from their ordinary duties with some one of the individual companies, know that an attack involving a certain number of men means that they will have to provide a given number of trains at the evacuation hospitals to carry away the wounded. Hence there are always reserve trains on hand.

The *Railway Age Gazette's* correspondent had the opportunity of visiting one of the permanent trains. Describing it, he said that the train consisted of 16 cars, several being of the center corridor type, with connecting platforms. There were 256 beds in the eight cars set aside for the wounded. The hospital staff of the train consisted of 33 men, including a chief surgeon, an assistant surgeon, a provision officer, a sergeant and 28 nurses. Eight of the cars were used for hospital purposes, other than the transport of wounded. One of them, placed in the center of the eight transport cars, was a pharmacy and operating car, a made-over freight car rebuilt at the expense of W. B. Hardy, of Chicago. On its side, near the red cross emblem, was painted the American flag. At the end of the train was the car in which lived the 28 nurses. At the head, next the engine, there was a provision car, a short box car fitted up with closets for linen and blankets, and drawers for the storing of wine, sugar, rice, coffee, meats and vegetables. Behind it came a car for the surgeons and a kitchen car containing also space for the storing of dirty linen and cotton, this material having to be burned so infectious disease might not be spread.

England's Ambulance Trains

The British have had the complicated problem of carrying their wounded from their many miles of front in France, along their newly built railway lines to the channel ports, thence across to England on hospital ships and finally to the interior hospitals on other ambulance trains. These trains both for use in France and England have been supplied by the English railways, which have taken great pride in turning out equipment of very high grade.

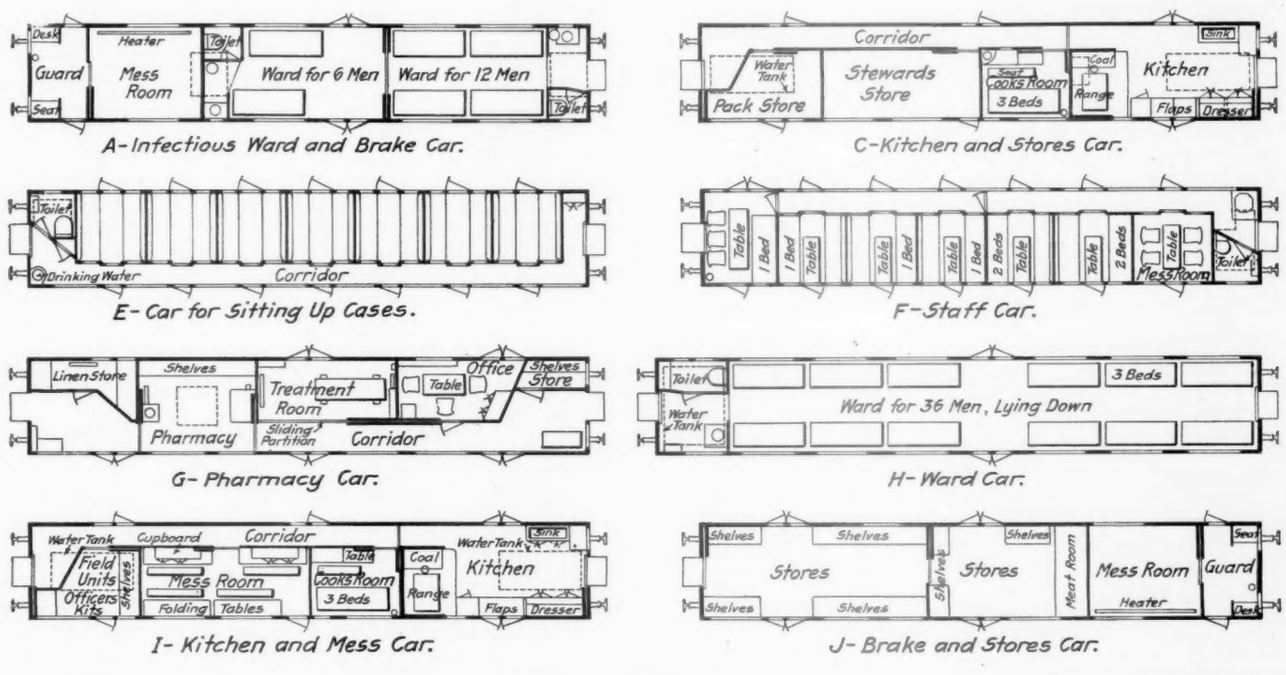
Among the railways that have done considerable work


WARD CAR ARRANGED FOR LYING-DOWN CASES
WARD CAR ARRANGED FOR SITTING-UP CASES
THE GREAT EASTERN'S AMBULANCE TRAIN No. 20.
WARD CAR FOR INFECTIOUS CASES
WARD CAR ARRANGED FOR CLEANING PURPOSES
A VIEW OF THE KITCHEN
A VIEW OF THE PHARMACY

Interior and Exterior Views of a Typical British Hospital Train

along this line is the Great Eastern Railway, the general manager of which is an American, Henry W. Thornton, who was formerly general manager of the Long Island. Train No. 20 has been in service in France for many months, and is typical of the excellent hospital trains that have been supplied. It consists of 16 cars, including an infectious ward and brake car, a personnel car, a kitchen and stores car, five cars for sitting-up cases, a staff car, a pharmacy car, four ward cars for lying-down cases, a kitchen and a mess room car, and a brake and stores car. The train carries 162 lying-down cases and 280 sitting-up cases, or a total of 442. The staff of 42 persons includes four medical officers, two sisters and two nurses, and nursing orderlies, cooks, stewards and train crew. Nine of the 16 cars in the train were built new for the hospital train service, or were adapted, rather, from coaches in process of construction; five cars for sitting-up cases were converted from third class cars and the staff car was originally a composite car. The exterior of the train is lead and provided with drain holes so that they can be flushed out thoroughly.

"Thirty-miles-an-hour hospitals" is the term one wounded officer has used to describe one of these English trains that took him from the front to Boulogne on his way to England. The writer speaks of the "most inviting first-class compartment," into which he and his companions were ushered, the wards, "cool visions of clean white enamel and spotless linen," with their beautifully sprung beds; the kitchen, dispensary, living quarters for the staff, and the "homelike" little bedrooms, "with their green casement curtains and pin-cushions and other feminine knick-knacks swinging in the windows." Judging by his description, the train possessed every home comfort, from aspirin, cushions, and cigarettes to grilled chops, pale ale and whisky and soda, so that the five hours' journey was "as near a positive pleasure" as it could have been. The writer's commendations were very pertinent, because he had had experience with the Red Cross trains which



The car designated by B in the diagram of the train itself is the personnel car and is similar to the cars designated E. Car D is also a car for sitting-up cases, and differs from the cars designated E in that it has bent wood seats whereas the others have leather cloth seats.

Plan of the Great Eastern's Ambulance Train

painted khaki with a distinguishing red-cross on the side of each car.

The four ward cars for lying-down cases are each 54 ft. long, are open throughout their length and have a lavatory at one end. The beds are suspended on brackets along each side in tiers of three, there being 36 beds in all. The car may be arranged also for sitting-up cases, accommodating 48, by folding back the middle tier of beds, and arranging the mattresses on the bottom tier to form couches. Ample space is allowed between the beds to enable the stretcher bearers and attendants to pass, but when extra room is required, such as for cleaning, etc., the entire three tiers may be swung up against the sides of the car. The cars are steam heated, electrically lighted and equipped with electric fans. Two portable fans are also provided in each car for poisonous gas cases. Every effort has been made to secure the utmost cleanliness. The interiors of the cars are painted white. The floors are covered with linoleum, and all corners are rounded. The floors of the lavatories are lined with

were used in France at the beginning of the war, "which usually consisted of half a hundred box cars, normally used for the transport of goods, which started and stopped in the series of jerks and the deafening clamor of any goods trains."

Canadian Pacific Hospital Cars

It has been necessary for the Canadian roads to provide a number of hospital cars, most of which have been converted from sleeping cars. In bringing back the wounded soldiers from abroad the Department of Supplies and Over-Seas Transport is notified in advance of the number of injured men and the number of cot cases. Those who are able to sit up can be provided for in Pullman cars, but the cot cases are transferred from the ship to a bed in the hospital cars. These cars are arranged to carry either eight or thirteen men and such a combination is used as will most nearly meet the requirements. The average number of cot cases on each ship is about 30 and the maximum number of such cases which

have been received on any one ship up to this time was 75.

The Canadian Pacific, by arrangement with the military authorities, has recently fitted up six new hospital cars, which accord with the most modern ideas of hygienic and medical efficiency and combine all possible facilities for the easy and comfortable transport of the wounded Canadian heroes returning from the European battlefields.

The cars, which have been approved by the Hospitals Commission, are built on plans which the company prepared two years ago with certain innovations found valuable by the French and British railways in transporting wounded men.

There are three units of two cars each, making six cars in all, each unit consisting of a composite car and a ward car. The former contains six cots in addition to quarters for the medical officers and nurses, while the latter accommodates 14 patients. The nurses' accommodation is equivalent to the drawing room on a standard sleeper, with a toilet room annexed, upholstered in leather. Facilities are provided for storing baggage and there is also a kitchen similar to those in tourist sleepers, so that special food can be provided for the patients when necessary. The medical officers' quarters are in the form of a compartment with upper and lower berths and a small dispensary. The ward car contains one large room, the length of a standard sleeper, with lavatories at each end.

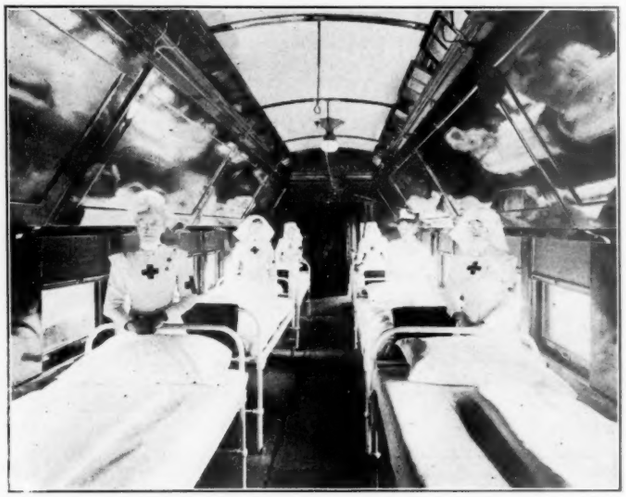
Standard hospital cots are installed in both cars; the floors are covered with linoleum and the aisles carpeted. A special feature is provided by a "bad weather entrance"; the composite cars have two side doors in addition to the usual one at each end, and the side doors, through which patients will be received, are fitted with very heavy curtains which can be drawn close in bad weather so as to afford full protection from draughts to the patients already within. The cars are distinguished easily from all other cars by the large Red Cross painted on either side of the words "Military Hospital."

What America Has Done

America's experience with hospital trains lies in the immediate future, rather than in the present or in the recent past. We have, however, sent over a little money to France for hospital trains. We have built only one or two modern hospital trains ourselves, but any one who knows what American railwaymen can do knows that the hospital trains that is a first-aid patient car, with a dressing room and pharmacy at one end and 12 beds in the other.

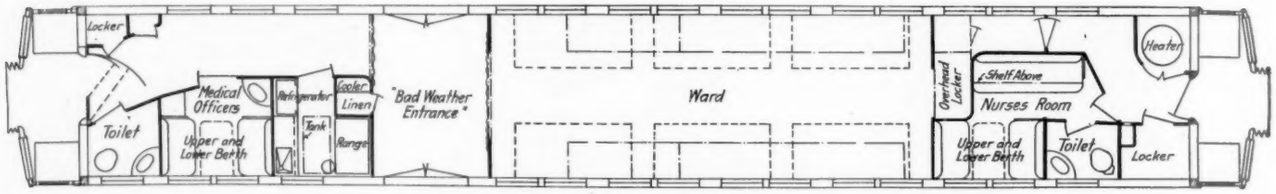
The eighth car is a remodeled parlor car with storage possibilities for the train and also 12 hospital beds. All these cars except the first have side doors for more readily handling patients. The ninth car is a standard tourist car with 16 lower and upper berths and is meant for patients suffering from minor injuries and ailments. The last car is a standard drawing room steel underframe Pullman sleeper for the officers. Each car in the train is lighted by axle generators and each has at least four electric fans. There is an extra large water supply, especially in the kitchen and first-aid cars.

America is going to add other hospital trains to this one



Ward Car of Canadian Pacific Train

furnished for service on the Mexican border, many for use in America and possibly some for use in France. Those built for use in this country will, no doubt, contribute considerably to the science of handling sick and wounded on the railways, and particularly over great distances and during extended periods of time. Just how we shall furnish equipment for use in France is a question. Presumably the



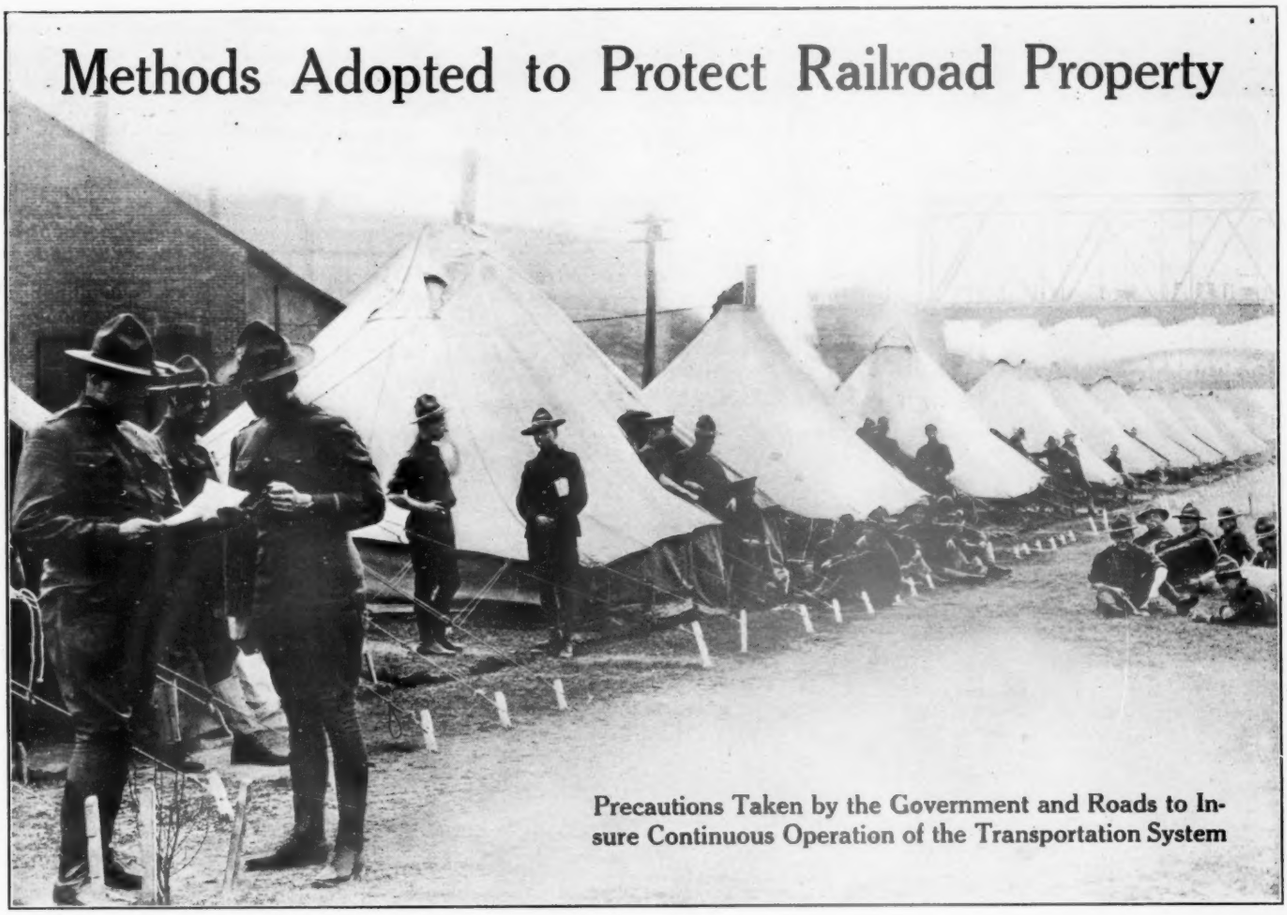
This Car and a Ward Car Constitute a Unit of the C. P. Hospital Train

may be built in America in the next few months will be as good as any.

In the *Railway Age Gazette* of December 1, 1916, there appeared a description of a hospital train built by the Pullman Company and made ready for service on the Mexican border 20 days after the order was received. The train contains 10 cars and has a capacity of 258 patients and attendants. The first car is a kitchen car made from a standard 16-section tourist sleeper and containing in addition to the kitchen, 14 lower and 15 upper berths. The second car is also a standard 16-section tourist car with one compartment made over into an office for the personnel. The third, fourth and seventh cars are remodeled tourist cars made into ward cars containing 14 regulation hospital beds, the upper berths being retained for moderately sick patients. The fifth car cars for use in ambulance service abroad will have to be newly built, for it is doubtful if the heavy American equipment can be easily adapted for use on railways across the seas.

Allocation of Railway Traffic in England.—In consequence of heavy and increasing pressure upon the railways it has become necessary for the various railway companies' routes and facilities for the conveyance of merchandise by freight trains to be co-ordinated, and on and after May 1, 1917, and until further notice, traffic for conveyance by freight trains between certain points will only be accepted and conveyed by selected railway routes. This arrangement will facilitate through loading to destination and tend to a quicker rail transit.

Methods Adopted to Protect Railroad Property



Precautions Taken by the Government and Roads to Insure Continuous Operation of the Transportation System

Soldier Encampments on Railway Property Are Now Familiar Scenes.

IN placing the railroads in a position to render the most efficient service to the country in war times, one of the most important problems met is that of maintaining unbroken lines, continuous operation and uninterrupted service. While it does not follow that the destruction of a single structure in a line renders that particular line useless as a link in the transportation system of the country at large, it does follow that its efficiency will be impaired and that much time will be lost through the necessity of making detours around that portion of the line temporarily out of service. To avoid this loss of time and the destruction of property and to secure the utmost efficiency with existing facilities it has been considered of primary importance to place guards at the larger railway structures.

Realizing the vital necessity of continuous operation even before this country became involved in the war, many of the railways took on their own initiative certain precautions, such as placing watchmen on important bridges and structures, in order that, insofar as possible, with the forces available, breaks in the line resulting in interruption of service might be prevented. Simultaneously with the declaration of war the railways were relieved of this responsibility in most cases and the protection of the strategic points and structures on the various lines was assumed by the government.

This protective work is being done almost entirely by the members of the National Guard, the soldiers being assigned to the work through the headquarters of the six army departments. Usually the department commanders or representatives of the American Railway Association at the army headquarters have called on the railroads to advise where the guards were needed and orders have then been given to the colonels of the National Guard regiments to assign the requisite number of men to the different points.

The duty of the guard is to patrol the property assigned to it for a certain number of hours per day and to prevent all but duly authorized persons from approaching or entering upon the patrolled districts or structures. All persons approaching such districts, whether employees of the railways or not, are halted and are allowed in patrolled territory only on presentation of the proper credentials. All persons not supplied with permits to enter are warned away, and in extreme cases where resistance is shown are forcibly ejected or arrested.

Men on guard duty live in the districts to which they are assigned. They are usually housed in regulation army tents, have their own mess and prepare their own meals. In many cases, however, the railroads are co-operating with the soldiers and are furnishing railway cars for living quarters for their comfort and to add to their effectiveness. These cars are cabooses, or converted freight or passenger cars; in some cases the regulation maintenance of way service cars, and they are usually placed by the railroads adjacent to the patrolled districts.

Under the arrangement in effect the day is divided into four periods of six hours each. The men of a particular detail are on duty two hours of each period after which they are relieved by their companions.

The points which the railroads consider vital and necessary to guard include the principal bridges, tunnels, waterfronts, piers, docks and other important properties. In determining these points the chief consideration is that of the importance of a point or structure in its relation to a whole line or to the transportation system of the country as a whole. In the case of structures, size is also considered and the decision as to whether or not a guard should be placed at certain structures usually is dependent upon the time which

would be necessary to restore traffic if the structure were destroyed. Where temporary repairs can be made and traffic resumed within 36 to 48 hours or less guards are not usually placed. For railways reaching either the Atlantic or the Pacific seaboard or those reaching the Great Lakes it is as essential to safeguard the pier and dock service so that they may be kept in continuous operation, as it is to maintain an unbroken line, for any interruption to this service means delay in the transportation of materials and supplies to the allies. In determining the number of soldiers to be assigned to guard a certain structure it is also necessary to consider its size and importance to the remainder of the particular line.

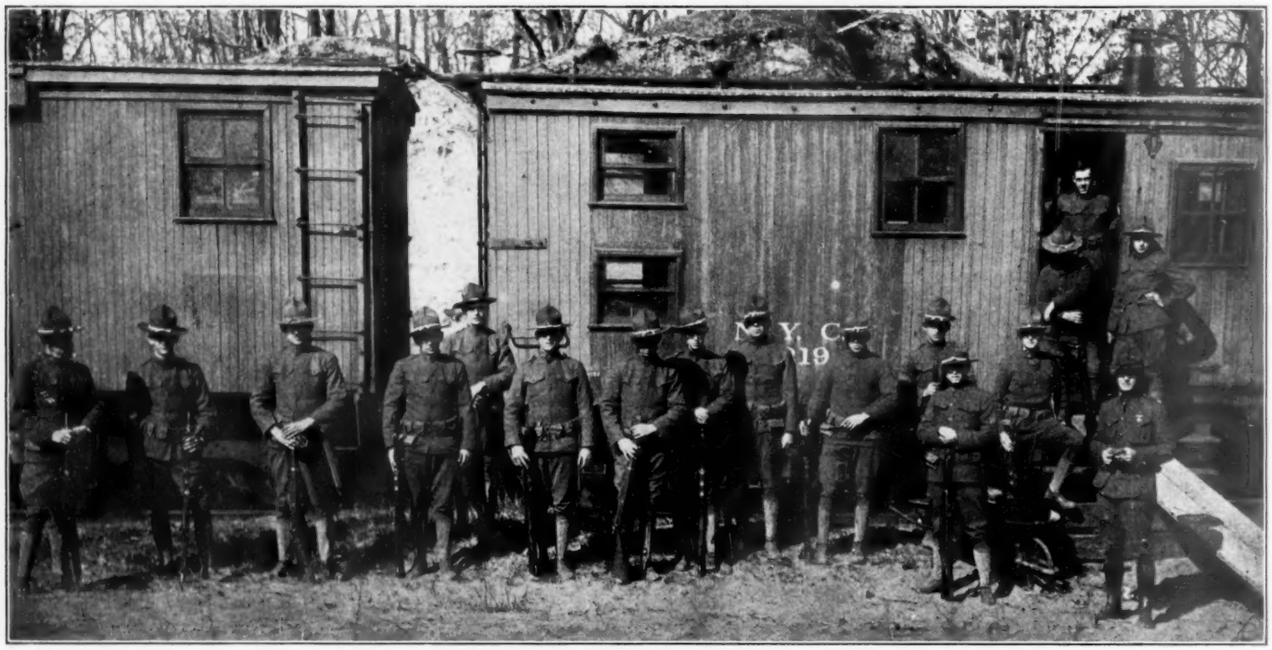
In the case of structures which, if destroyed, would affect only a relatively unimportant line, or where service could be continued by means of a comparatively simple or short detour, the number of guards is less than that at the more important bridges, which if destroyed, would occasion comparatively long detours and consequent serious delays in service. At the bridges which are vital to the continuous efficient operation of intersectional traffic lines and therefore to the entire transportation system of the country, the guard is greatly increased and other means of protection are employed.

The necessity of maintaining continuous service over the intersectional lines is evident. Even if a bridge to be guarded is so located that a simple detour may be arranged and operation continued around the break over a parallel line, it is important to avoid the necessity of detouring, as the diverting to a parallel road of the great amount of traffic which passes over one of these lines will necessarily create an overload on the second line and result in serious delays to the traffic of both. Where simple and comparatively short detours cannot be arranged, the guarding of the structure is even more important.

Additional Protective Measures

While the government has issued no orders in this regard other than suggesting to the various railroads that the effectiveness of their own watchmen can, in some cases, be increased, one of the principal and most effective steps taken by the railroads to co-operate with the soldiers has been to place lights at the more important bridges. The lights are particularly valuable at bridges that are long and high and that have parts about which it is difficult to maintain an efficient watch at night. With the aid of reflectors or other means, an illuminated area can be created around the intermediate piers and other vital points of such structures, making them visible to the soldiers stationed at points of vantage and rendering it difficult for any person to approach unseen. The light is furnished in various ways. Where commercial current is available, it is generally utilized and where it is not, portable electric light plants have been set up in many cases to supply the current. At other points carbide lights and reflectors have been placed and in some cases oil lights are used.

The Baltimore & Ohio has installed both incandescent and searchlights at several of its larger bridges, using commercial current in all cases. The New York, Chicago & St. Louis has installed flood lights on five of its principal bridges, securing the current from portable electric light plants. Many other of the principal railroads have also provided lights of various kinds. As an example of the cost to the railroads of such protection, one of the larger plants on the Baltimore & Ohio was installed at a cost of $5,000 and the cost of current for the first month was $416.



Copyright by Underwood & Underwood, N. Y. **Bunk Cars Are Often Used as Barracks**

Another step which adds greatly to the efficiency of the protection that some of the railroads have installed is the provision of field telephones in the patrolled districts. Where it is at all possible these telephones are connected with the regular commercial telephone system. At other points the railroad company's wires are utilized and a connection is made with the nearest telegraph station. By means of these telephones it is easy for the officers to get in touch with the men on guard and in case of serious trouble for the guards to call for reinforcements.

Supplementing the soldier guard, many of the roads have also recruited their special agent forces to war strength. Usually the extra men employed are not supplied with firearms, but are equipped with night sticks. The duty of these men is to provide protection at the important points of the line where it is not considered necessary to place soldiers,

such as at interlocking plants, shops and other buildings. The Baltimore & Ohio has a large force of such watchmen and employs a special force to see that the men of the larger force are performing their duties in the proper manner. Where suitable boarding places cannot be secured, the men employed in this work are taken care of in camp cars supplied by the railroad.

As a precaution, some of the railroads stop all of their freight trains at tunnels and the more important bridges to take off all train riders. This work is in most cases done

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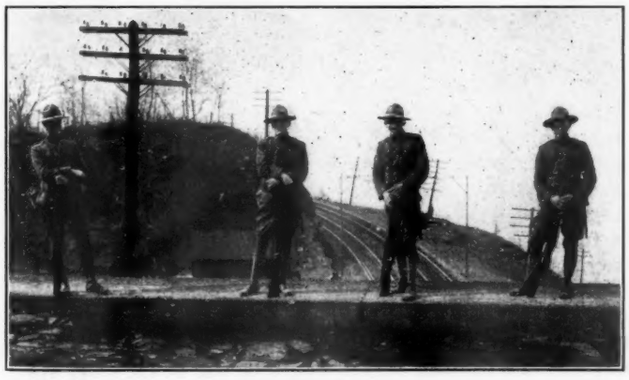
GENERAL SUPERINTENDENT

COLONEL, FOURTH MARYLAND INFANTRY U. S. A.

Form of Permit Used by the B. & O.

by the special agent forces. On passenger trains the rule is generally enforced, prohibiting all persons from riding on rear or other platforms. Passengers on observation car platforms are also requested to ride inside while passing through the tunnels or over the bridges. With steam operation the windows are usually shut, as a matter of course, when passing through tunnels, but in the electric zones in the vicinity of New York, closing the windows in the tunnels is enforced as a rule.

In order to secure the limit of effectiveness from the patrol, the Baltimore & Ohio issues identification cards or permits to persons whose duties make it necessary for them to go upon the tracks or property of the company. A complete record of the persons to whom such permits are issued is kept, making it possible to keep a check on all visitors to the patrolled districts. These permits are signed by the commanding colonel and the general superintendent of the



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Guarding a Bridge

road. Annual or other passes are not honored as permits to enter the patrolled districts. The officers and men of boats tying up at the docks of the company must also secure permits from their captain to come ashore and without one no one is allowed to go aboard the vessels.

Accidents to soldiers, often with fatal results, have been frequent, occasioned primarily by a lack of knowledge on the soldier's part of railroad conditions. To ameliorate this condition, Colonel Jones of the Fourth Maryland infantry has issued the following order for the guidance of all concerned, dated May 1, 1917.

"The following 'Safety Rules,' suggested by the safety bureau of the Baltimore & Ohio Railroad Company, are intended to reduce the risk attendant on guard duty on railroad structures, and are published for the guidance of all concerned, and will be strictly observed:

"KEEP OFF ALL TRACKS except in the discharge of duty, and when stepping out of the way of approaching trains, engines or cars, go far enough to clear all running tracks.

Telephones Add to the Efficiency of the Guard

"Where there are two or more tracks, when practicable travel against the current of traffic, or in other words, in the opposite direction run from that in which trains are usually operated, keeping a sharp lookout, however, in both directions for approaching trains, as they may be operated in either direction as the conditions require.

"Look in both directions before stepping upon any tracks. Be particularly careful when crossing tracks near cars or locomotives, and when about to step from one track to another, as trains are run in either direction on any track when necessary or expedient.

"Do not attempt to crawl under a car or pass between cars separated but a short distance without knowing the proper protection against movement has been afforded. Do not step on the coupler when crossing between standing cars.

"When possible avoid walking through escaping steam.

"When coming out of buildings adjacent to tracks, look in both directions before stepping upon the tracks.

"Do not take short cuts over dangerous places where other ways are available and known to be safe.

"Do not ride upon freight trains or locomotives, unless so instructed by the proper authority.

"Do not board or alight from trains at night unless you are sure that there are no obstructions or openings that may cause injury. When practicable, board or alight from the rear of the train, car or engine.

"When riding on passenger trains alight from the side intended for passengers, but do not alight while the train is in motion.

"Cultivate careful habits. By so doing one disciplines himself, and when caution becomes a habit there will be few accidents."

THE RAILROAD COMMISSION TO RUSSIA

The American Railroad Commission to Russia headed by John F. Stevens, arrived in Petrograd June 13, and was met at the Nikaloi station by David R. Francis, the American Ambassador, the staffs of the Embassy and the American Consulate and by N. V. Nekrasoff, minister of ways and communications for Russia. The commission traveled across the Pacific ocean and on its way to Petrograd passed through Tokio, thence to Vladivostok and over the Trans-Siberian Railway.

Mr. Stevens emphasized that the commission's aim was to assist the Russian people and the Russian Government especially in railroad affairs by placing at Russia's disposal America's technical skill and industrial resources.

"The commission is strictly official," said Mr. Stevens. "Its primary object is to help the Allies in the war against Germany. The commission will establish general relations with the Russian Government, and also especially with the railroad and war departments. As soon as we have formed judgment as to the special defects and needs of the Russian roads we shall enter into negotiations with a special technical commission in the United States with the aim to supply the necessary materials at the quickest possible moment. We are further ready to facilitate the supply to Russia of war materials and iron and coal.

"Having already examined at considerable length the Russian railroads, we have a high opinion of the merits of the railroad personnel. With improved technical equipment Russia's railroad system would be one of the chief systems in the world."

The commission consists of John F. Stevens, formerly chief of the Panama Canal and more recently a consulting engineer in New York, who is chairman; W. L. Darling, of St. Paul, formerly chief engineer of the Northern Pacific; Henry Miller of St. Louis, formerly operating vice-president of the Wabash; George Gibbs, a consulting electrical engineer of New York who has been in charge of extensive railroad electrifications; and J. E. Greiner of Baltimore, until recently chief consulting engineer of the Baltimore & Ohio.

The American Railroad Commission to Russia

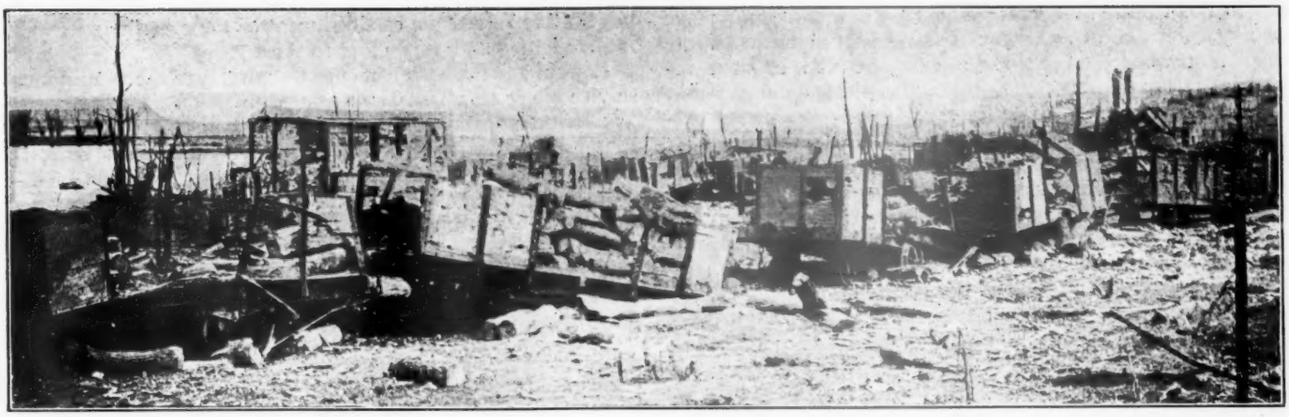
George Gibbs

John F. Stevens
Chairman

W. L. Darling

H. Miller

J. E. Greiner



Photograph from Underwood & Underwood, N. Y.

German Shell Train Smashed by British Shells at Clery Station, Near Peronne

How Railways Behind the Front Make History

The Attack on Verdun Was Largely Influenced by the Fact That the French Had Few Lines at That Point

IN a single week of the attack on Verdun the Germans fired 3,000,000 shells, weighing about 47,000 tons and requiring something like 240 large trains to carry them. In the entire 30 weeks' campaign both the French and Germans made an expenditure of 60,000,000 shells, weighing about 3,000,000 tons. The German superiority in shell fire, both as to quantity and effectiveness, was eclipsed some months ago by the Allies, but the Germans used 37 trains of 40 cars each for transporting the ammunition used in the taking of Hill 304 and the Meuse. They poured 400 trainloads of shells on the Russian fortress of Ossowiecz.

The "Influence of Rail Power Upon History," is the title that might be used for an article on the importance of the railways in the war, for as the present great European struggle develops towards its climax, it becomes increasingly clearer that there is only one factor operating more decisively than that of rail-power, and that is sea-power. It has been proved that man-power, money-power, and industrial power can largely be stultified in war by insufficient rail-power; while, on the other hand, a highly-organized railway system has been able greatly to increase the effectiveness of inferior man-power, money-power and industrial power.

As in so many other important considerations on the material side, Germany foresaw more clearly than France or Russia the importance of rail transportation in the event of a general European war, and as a consequence she entered upon the present struggle with a strategic railway system not only greatly superior to that of her enemies, but also one that proved more nearly adequate to the demands made upon it than perhaps any other department of the war. Germany was scarcely less surprised than the Allies at the tremendous shell consumption—only her superior industrial organization enabled her to cope with the shortage more readily—but her strategic railway system has never, in spite of the unprecedented demands made upon it in swinging armies back and forth between the eastern and western fronts, or moving them back and forth, to strike or repel, along either of these fronts, failed her from the first. It is not the railways that have failed Germany during her retrograde movement of the last three months, but only the fact that the passing of the initiative to the Allies has deprived her of the power to take full advantage of them.

France's pre-war railway system might best have been described as resembling the spokes of a wheel radiating from Paris as a hub. There were fairly adequate provisions for rushing an army to her German frontier, but not for throwing men towards Belgium, or for moving them back and forth along the line from the North Sea to Switzerland, now known as the western front.

The British Railways in France

France's railway system, further, did not anticipate the use on her own soil of several million British fighting men. The British armies now occupy something like 125 miles of front in France. To supply these armies they have had to adopt such ports as Havre, Calais and Boulogne as military supply stations, and from them they have had to build new railway lines to the east and south. One observer has estimated that up to the beginning of the spring drive this year they had built not less than 4,200 miles of light and standard gage railway in France. No doubt this mileage has been considerably increased since.

"While the British occupied the front from Ypres to La Bassée," said Frank H. Simonds, the military expert of the New York Tribune, recently, "they were well served by the railroads from Calais to Lille. But as their line moved southward they were faced by the necessity of depending on single track lines not designed to carry heavy traffic, lines which ran at right angles to the main trunk railways leading southward toward Paris. This condition was entirely satisfactory to the French while they held the lines between La Bassée and Roye, because the French were supplied from the south and from Paris.

"But before the British can take over a sector they have to reconstruct railroad lines and join them up with their bases, which are on the coast and not in Central France. The result has been an immense railway construction in France by the British. Whole British lines have been transported to the continent, British railway men have taken over the task of refitting and rebuilding lines, and Sir Douglas Haig told me of one instance where he asked the railroad men of England, who had visited him, for prompt assistance and they promised him eight hundred miles of line in an incredibly short time, when his request had been for three hundred."

Military Railways vs. Motor Trucks

Germany's railway system, on the other hand, might be described as a cobweb—with the ends of the strands reach-

ing to the frontiers—about which the "spider" could move in any direction to attack or defend. It included all the lines that were essential for a complete and efficient industrial railway system, with the addition of a number that were not in the least demanded by normal commercial exigencies. These latter were mostly lines connecting the eastern and western frontiers, or branching from these lines to convenient concentration points. From certain of these "nodal centers," also, it might have been noticed that rather more railways radiated than the size or commercial importance of the town seemed to warrant.

Quick concentration and a speedy movement back and forth between her French and Russian frontiers—these were the main purposes of the strategic system which Germany built upon the groundwork of her commercial railways. In its salient features it might have been, and probably was, planned at the close of the Franco-Prussian war. When the possibilities of the motor truck for army transport began to become apparent a decade or more ago there were those in German military circles who strongly advocated curtailing the very expensive strategic railway program and developing a great motor truck service to perform the same functions in the event of war. These urged that, whereas the strictly strategic railways would probably prove unremunerative indefinitely, the motor trucks could be profitably employed in regular commercial service right along.

The German General Staff ruled in favor of a continuation of the construction of strategic railways for two reasons—first, because, in the event of a general European war, Germany would probably be entirely cut off from rubber and very largely from motor fuel, and, second, because, in their opinion, the motor could never work so cheaply or so rapidly as the railway on long distance hauls, and probably not even on short ones. In no other one particular has the judgment of those who planned the war for Germany been so completely vindicated by subsequent events.

English Soldiers on the Continent

Germany built up an excellent motor truck system, but kept the railway as the "wheel-horse." France banked heavily on motor trucks and neglected the building of strategic railways. Just how much of a price France has paid for this neglect it would be hard to say, but it is conceivable that an adequate system of railways paralleling the German and Belgian frontiers might well have made it possible for her to have forced the establishment of the present front well into Belgium and very close to Alsace.

It would not do for a moment to overlook the tremendous service motor transport has rendered to all of the belligerents. Von Kluck's army was turned back from the Marne by a French force thrown on his flank in the hurriedly requisitioned taxicabs of Paris, and "unconverted" London omnibuses contributed greatly to the remarkable defensive of the first British contingent sent across the channel. So, also, were motors of incalculable value to the Germans in their first swift drive across Belgium and into France, and the great German onslaught upon Russia would have been impossible without motor transport to take the place of the destroyed railways. But these operations seem clearly to define the limits of the employment of motor transport on a really large scale. For emergency work, for cutting "cross-country," for following a retreating army into a country where the railway has been destroyed or never built, the motor has no equal. But just as soon as an army settles down so that its transport moves regularly along established routes, experience has proved that motor service cannot be too expeditiously replaced by that of rail.

Up Two Feet Out of the Mud

Verdun

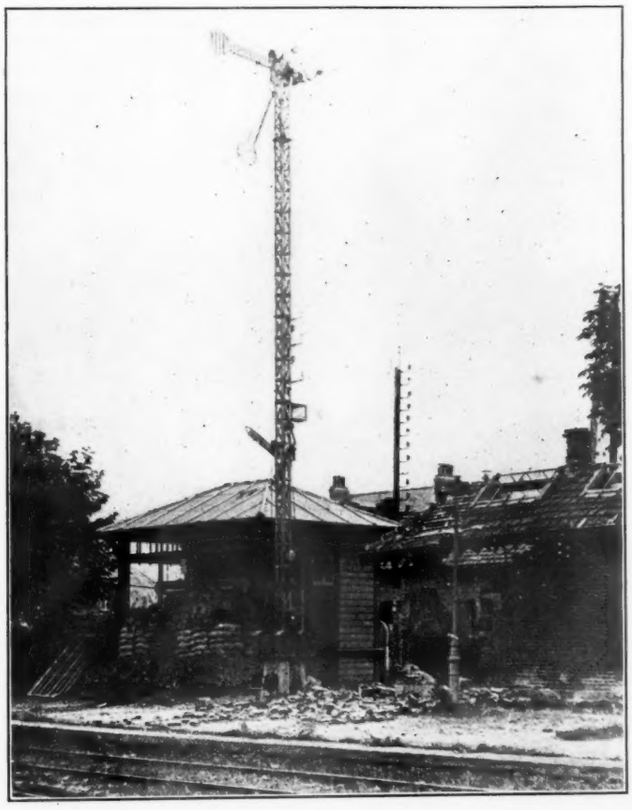
The influence of rail power upon history and the advantage of rail transportation as against motor trucks are little better shown than by the transportation situation at Verdun. It is now universally conceded that one of the most important reasons why the Germans chose to launch their attack upon Verdun was their transportation superiority at that point. The French had one ordinary double track line, the Sainte-Menehould-Verdun line, which was within easy range of the German guns south of Vauquois, and a narrow-gage line from Verdun to Bar-le-Duc. The Germans had 14 strategic lines, eleven of which they had specially constructed. The French General Staff itself speaks of this situation in this wise:

"From the German point of view there was nothing paradoxical in the selection of this battlefield, though many critics have thought otherwise. To bring your enemy to action with a river behind him, and when his sole railway communication is at the mercy of your artillery, is always an inviting prospect, and that was the situation at Verdun. But the German General Staff reckoned without the French General Staff. Ever since February, 1915, the question of manoeuvring, maintaining, supplying and reinforcing an army of 250,000 men on the right bank of the Meuse had been studied to the last detail on the assumption that railway communication would be impossible. The development of our mechanical transport by road at that moment—it has been almost perfected since—was such that at a moment's notice we could bring up troops, supplies and ammunition, everything necessary to the defense of Verdun, by road.

This is the reason why we have been able to maintain our defensive lines at Verdun and bring up without any hitch or unnecessary loss thousands and thousands of men who have carried out the plans of our Staff."

But while the motor transportation did such wonderful work it is not agreed that it was done as well as it could have been done by railway lines.

"After the defective organization of the northern sector of Verdun," writes Herve in La Victoire of March 24, 1916, "our greatest handicap was the insufficiency of our railway communications with the fortress. . . . When a supply or ammunition wagon leaves Paris it has only one line to Verdun, that which passes through Sainte-Menehould. It is



Photograph from Paul Thompson, N. Y.

Railway Station in the Somme

true that before the Battle of the Marne there was another route from Paris to Verdun for freight traffic—the Paris-Commercy-Toul-Nancy line. At Commercy the train was switched off northwards and reached Verdun by the Commercy-St. Mihiel-Verdun branch, which follows the left bank of the Meuse. Unfortunately this branch was cut in October, 1914, when the Germans by a bold stroke seized St. Mihiel, after which Verdun was isolated from Commercy and railway traffic ceased by that route.

"At Bar-le-Duc, on the great Paris-Commercy-Nancy line, there is a branch line to Verdun which can be used at a pinch, though this is a narrow-gage line which will not take the rolling stock of our main lines. It is in fact a mere departmental line. Trains for Verdun sent by this route could get no further than Bar-le-Duc, where they would have to be unloaded and their stores, munitions, etc., transferred to the departmental tramway from Bar-le-Duc to Verdun. It is not difficult to imagine the amount of labor and loss of time involved in that operation.

"Thus our only practicable railway for the conveyance of reinforcements, supplies and munitions to Verdun was the main line Paris-Sainte-Menehould-Verdun, which was exposed to long-range gunfire from the German artillery in the region of Montfaucon, only ten miles away. In these circumstances railway transport could not be counted on.

"Our official commentator tells us that our General Staff had provided for this very emergency by organizing an admirable system of motor transport. But I am still convinced that if that splendid service had been supplemented by a good railway system our Verdun front would have been even better supplied with reinforcement, men and munitions, and with greater speed, I still believe that during the seventeen months of German occupation of St. Mihiel we made a great mistake in not widening the narrow-gage Bar-le-Duc-Verdun line to enable it to relieve the Paris-Sainte-Menehould route and in case of necessity replace it. I admit that a railway is vulnerable to gunfire, but engineers do not take long to repair damage to the permanent way.

"These are the two outstanding omissions, the two cardinal errors which the official report reveals. That we recognize them as such in no wise diminishes the gratitude of the nation to the military leaders who, in breaking the German assault on Verdun, have just gained a victory which, if continued and followed up, will ring through the world like the triumph of the Marne itself."

The Light Railway

The incalculably and increasingly important part played by the railway—from the four, six and eight-track broad-gage trunks to the handcar lines in the trenches—is one of the most remarkable developments of modern warfare.

Some of even the heaviest of the great German howitzers were fitted with "caterpillar wheels," so that, drawn by a specially-built tractor, they were given a certain mobility independent of the railways. In getting them into position against Liége and Namur, and several other points, in the early weeks of the war, some of these monsters were moved about "on their own." They were, however, restricted to the smoothest and most heavily metaled roads, and even these were torn up so badly that it was a common saying in Belgium that the wheels of the "42's" did more damage than their shells. Since the western line has been more or less

Photograph from Brown Brothers, N. Y.

Tommies Exchange Jokes with German Prisoners

definitely established, the big German howitzers have gone by rail direct to their emplacements, where even their shells are brought to them on specially built little tramways. Indeed, most of the big guns on both sides of the western front now have little railways as "hand-maidens," these latter, if not artificially "dug-in," being at least given the protection of rows of trees or cut boughs.

The frightful manner in which any kind of a tired vehicle

—from a wheelbarrow to a motor truck—cuts up roads has hastened the use of the rail. In some camps one sees the huge cauldrons of stew or tubs of dirty dishes making their way about on little railways, and a single ground rail to take the wheel of a pushbarrow has been tried with success.

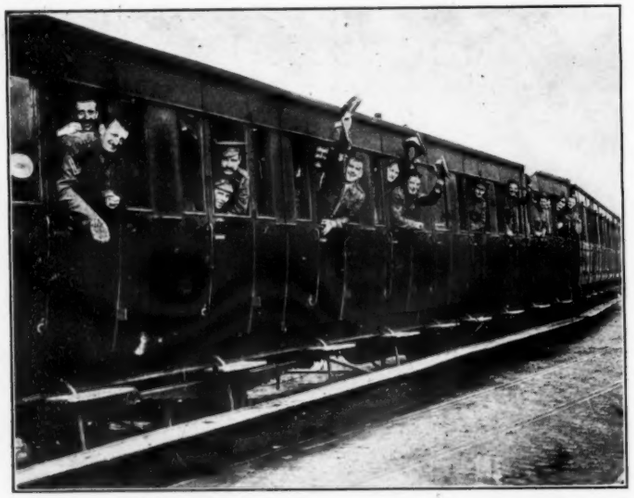
The transporting of the heavier guns to their positions has compelled the adoption of equipment of a new and special nature. The English and French for some time have been mounting their guns on a massive girder structure, which, in turn, is supported on a series of articulated trucks, or movable gun platforms, mounted on three or four axles apiece. Any other method of transporting this heaviest artillery would be inadequate; it is, therefore, necessary to build railways prior to the guns being advanced to new positions.

An article by our European correspondent elsewhere in this issue tells of another new development in the form of heavy artillery mounted on railway cars. This, incidentally, is not an innovation, but rather an adaptation of the armored car first used in the Civil War. Or perhaps it would be more correct to say that it is more particularly the adaptation of an idea worked out by a Union artillery regiment which placed a heavy mortar upon a small railway car for use in the bombardment of Petersburg. The gun was called the Dictator and excited no small amount of comment. The Italians have even mounted fairly heavy guns on motor trucks with considerable success.

It is interesting to note that the armored car for small arms firing has not been used extensively in the present conflict. The big "tanks" have proved far more useful and effective.

Construction and Destruction

In railway destruction and reconstruction the war has developed nothing especially new. The vulnerable points of a line are its tunnels and bridges, and the dynamiting of



Photograph from Brown Brothers, N. Y.

English Troops Bound for the Front

these is the last work of a retreating army. If there is time, this is followed by the tearing up of the rails and ties, The latter are then stacked and ignited, after which the rails are thrown on the fires, the heat of which warps and twists them beyond any further usefulness. When steel ties are used, as in most of the new light railways, the destruction of the rails involves more time and trouble, as some other form of fuel has to be provided.

The Belgians made rather a poor job of their railway destruction, and the Germans, prepared against every contingency, were hardly more than thrown out of their stride by it. In several instances dynamited tunnels were reduced in a few days to open cuts by the simple expedient of throwing in men as thick as they could stand and swing shovels, and passing the dirt down successive terraces to trains which were backed in at the bottom on the relaid tracks.

The Serbians, on their line along the Vardar, performed a far completer work of destruction than did the hard-pressed Belgians. The almost endless succession of bridges and tunnels, and the great amount of rock work, rendered this line especially susceptible to systematic tearing to pieces, and this the retreating Serbians did most successfully. Not only were the tunnels and bridges thoroughly blown up, but numerous little surprises in the form of cunningly concealed mines were well calculated to give the impetuous Teuton pause in his efforts of reconstruction. The many weeks which elapsed before the imperatively demanded connection

Troops Leaving Paris by Train

with Constantinople was opened indicated how thoroughly the Serb wrought, or rather unwrought.

In the case of a properly destroyed railway bridge across a broad river there is little to be done but to make such use as possible of the foundations of the piers and build all over again. This usually entails the breaking of rail traffic and the substitution of carts or motor trucks across a pontoon bridge. The surprisingly short time inside of which the Germans had trains running across some of the destroyed bridges in Poland is sure indication that the work of the retreating Russians was not effectively performed.

Destroyed culverts, road crossings and short viaducts can often be patched up so as to pass trains within a few hours, and an advancing army always plans to have the necessary materials—largely heavy timbers—ready to hand. When these fail, as not infrequently happens, the nearest available substitutes are thrown into the breach. The Germans restored several crossings with the timbers of a French château, torn down for the purpose, in their first drive into Champagne; and in following through the chaos left by the retreating Von Kluck a resourceful British sapper used a half-dozen wrecked and abandoned German motor trucks as the foundation of a hurried dirt fill he was compelled to make in the absence of any building material.

This precarious expedient, it is interesting to note, was successful to the extent that it passed safely a number of trains bearing the urgently called-for troops, and only collapsed, without serious casualties, under a returning train of wounded, whose engineer carelessly exceeded the two-mile-an-hour speed limit over the provisional embankment recommended by its resourceful builder.

[Note.—Much of the material in the foregoing article has been adapted from a similar article bearing the title "The Railification of the Front" which recently appeared in the Railway Gazette, of London.—Ed.]

Europe's Railroads Meeting Second Great Trial

All Countries Have Raised Rates and Cut Commercial Services. The Serious Russian Railway Situation

By Our Special European Correspondent

THE supreme test of Europe's railroads is now at hand. Even the unobservant public knows it. Along with food, fighting, victory and peace the subject of railroad transportation has become a matter of common conversation. In the hope of ending the war this summer, the Allies have prepared themselves on a scale that is so gigantic as to render commonplace the efforts of the early part of the war. The Germans have likewise prepared to meet this new effort in the hope of carrying the war along another year or until the Allies get tired first. On both sides railroading has assumed an aspect of importance never dreamed of in the happy, theoretic days preceding the war. Slowly, carefully, but ruthlessly, the railroads are being bent towards military aims. All kinds of efforts have been made to eliminate altogether passenger travel of the casual or pleasure kind. They are taking off dining cars, sleepers and first-class coaches. They will virtually do away with international travel. Travel even within the confines of any country in some places requires police permission. In the same fashion that we are now able to buy bread or sugar or meat only by ticket, so soon a railway ticket will be issued only as a necessity.

The first great trial of the railroads came with the mobilization at the first leap into war nearly three years ago. Since then wheels have turned and turned ceaselessly, until many have feared they would turn no more. We have just passed through the worst winter that has been known in Europe since the bitter cold of the Franco-Prussian war, or that of Napoleon's invasion in Russia. This winter has been one of death by sea and by rail. In the crowding of vast troop movements and of heavy military freights into this period preceding the spring campaigns, there have been more disasters than during any other period of the war. The actual number of victims is not known, nor the causes of the disasters. In France, in Italy, in England, in Germany, in Russia the war has not hitherto produced such a demand as this for transportation. In addition to the numerous furloughs granted men at the front, there have been rearrangements of numerical numbers on the fronts. New recruits have been sent by the hundred thousand to their stations. There have been heavy movements of crippled or invalid soldiers resulting from the clearing out of the hospitals to make places for the wounded of the summer to come. There have been huge quantities of new artillery and other supplies to be carried to the fronts.

These movements have been different from the first-of-the-war mobilizations in that they have been "through-train" affairs. Later in the year when the military plans of the Entente and of the Central Empires will have been more probably become clear that not one but several great transportation movements have taken place on an enormous scale. The Italian railways have been under an unparalleled burden, for the removal of troops to or from southern points. Their trains have been going day and night all winter long, on through journeys, north and south, over 1,500-mile distances.

The American troops sent to the Mexican border in Pullman or tourist sleepers should have seen a sight I witnessed several times at Italian way stations. A long line of freight cars would haul up on a siding and from off the straw covered car bottoms would leap lusty young Frenchmen or Englishmen out upon the gravelled tracks, shouting "Vive l'Italie," or "Hurrah for Italy," as the case might be, and hot footing it for the station restaurant or for the Red Cross lunch stand. There was no complaint of any kind from them about riding weary days and nights in box cars, without a diner hooked up conveniently. They hadn't ridden in anything but box cars since the war began, and indeed they were glad of the chance of dry shelter away from the trenches or the barracks behind the front lines. "It's a jolly lark, that's what," declared one blond English Tommy, as he asked for the favor of a box of matches for his pipe. But the end of this lark is not yet. These railroad activities are growing perforce and will continue to pile up far into the summer.

Plans to Handle the New Phase

How successfully the railroads will stand up under the coming pressure may hardly be forecasted. Their trials are manifold, and vary according to the time and country. As I have repeatedly pointed out, the general condition of equipment was reasonably good on all the railways of Europe at the beginning of the war, considering their local and special needs. The improvements so notable in the United States during the eight or ten years preceding the war had been reflected in Europe, particularly in locomotives and passenger equipment. The European custom of lasting construction, of stability, has served well for the war period when new equipment has been difficult to obtain. A deterioration of 25 per cent resulting from mere wear since the war began would be a high and almost preposterous figure. These difficulties of wear and lack of rolling stock can be partly remedied, as I will note later. Difficulties of personnel prevail on every side, and this cannot be remedied.

In Germany, for instance, this difficulty is most serious. Another curious and disturbing factor there is the lack of axle grease and the scarcity of lubricating oils. It has been reliably stated that there the scarcity of fats in foods has become such as to have produced a new skin disease. In France and Italy the effort to limit the consumption of coal, practically unavailable for the civil population during the past winter, has presented serious obstacles to railroad operation, though of coal there has so far been plenty.

This new phase, perhaps the final test of railroad efficiency and of its power to work on the accumulated organization of the past, is marked by several interesting features. The military and civilian managers of the railroads have entered into this final pull with the same degree of energy and preparation as the generals at the front or of the government financiers in the national capitals.

In France during the past three months the Paris, Lyons & Mediterranean has cut down its daily train mileage by 1,000 miles, and every other road has been forced to do likewise. The argument of Messrs. Herriot and Claveille, the transportation dictators, runs something like this: "If we can reduce the 511 million civil passengers per year to 300 million, there will be less coal to burn and more equipment at the disposal of the military authorities. If we can cut down the 231 million miles the French railways formerly averaged per year, we won't need to waste our war energies manufacturing new rails and new car wheels; we won't have to spend money abroad for this new equipment, and there will be just so much more money left for war purposes. When the war is over, the railways can make up their losses, that's all. Our first duty

is to the national defense. Civilians can do their traveling after the war. Merchants can ship their goods then too. Most of the commercial freights at present come under the head of luxuries, anyway. Let people wear their old clothes, their old shoes. Food may be shipped, yes; but even that shall not be shipped in excess of the immediate needs of the population. Let people eat less, have no more than their municipal card tickets call for. There will be time after the war to grow fat again. Let there be freight space to the sea ports for our commercial exports, since that means so much money in our pockets to carry on the war, so much less money to be borrowed abroad, but no freight space for foreign luxuries imported; we need the return freight space for our military imports."

The Allies' railways of necessity must adopt this line of reasoning and are adopting it, though it has taken them nearly three years. French and Italian exports to England have been eliminated and cannot take place any more, the line having been drawn in March. One of the sides to this general situation has been the eliminating of passenger holiday or reduced tickets, round-trip tickets, and particularly the free ride privilege. No less than 17,000 persons, it is stated, were so affected on the Italian railways beginning January 1. The free ride graft had been so abused in Italy that a train conductor was surprised to have offered to him in first class compartments a fully paid ticket; that is unless the passenger was a foreigner. In all of these countries, in addition, the person who now wants to ride first-class must pay at least 20 per cent more for his ticket. The through trains still running go at a reduced speed so that the Paris-Rome journey of 36 hours has been lengthened to 48 or more hours. Personal baggage has been limited to 200 lb. and fast freight shipments to 300 lb.

Special cars for government ministers and special trains for other personalities cannot be had for love or money. Victor Emmanuel III, king of Italy, ever a democratic person, set an example in this respect recently when he had to come from the army front, where he has been since the beginning of the war, to Rome. Instead of using the royal train, he took a seat in the ordinary through train running south, merely reserving for his party a few seats in a single compartment in one of the passenger coaches.

If Russian Railroads Had Been Prepared

The dominating factor of railroading in war times has never been so clearly illustrated as in the Russian political upheaval. I have no statistics showing exactly the number of free passes distributed among the bureaucracy there, nor of the criminal use of passenger trains to the exclusion of civil food and military freights, but reports from Russia for many months have indicated an unusually disturbed transportation situation. As early as the first of the year it was known in Paris and London and elsewhere that the city of Petrograd was short of provisions and was suffering severely. To say that the Russian political upheaval was directly caused by an inefficient transportation system may be farfetched, but now there is no doubt that this was one of the most important contributing factors that brought the political situation to a head. It may therefore go down in history that this magnificent empire changed policies and heads for the immediate reason that railroading was not administered on a practical basis. This fact should remain as a lesson to every nation that ever hazard will throw into a great war. Russia, with more food than any other country in the world during this period of short world crops, was starving because the food was not transported.

Another manner of stating the Russian situation would be to say that if Russia had begun the war with a fully equipped transportation system, such as that existing in France, or in the countries of her enemies, Germany and Austria-Hungary, the war might have been concluded a year or eighteen months ago. Lack of railroads has been the nemesis of this mighty people since the war began. In the words of Lloyd George, everywhere Russian armies have arrived too late, food has come too late, artillery and munitions have come too late. The best part of her railroad system along the German frontier was lost because the supporting lines of railway were insufficient. European Russia with a territory two-thirds as extensive as that of the United States and over one-half the entire Continent of Europe, entered the war with nearly 40,000 miles of railway or one-fifth the total of Europe or one-sixth that of the United States. Many of her railroads were operated in a primitive manner, burning wood instead of coal. For 100 km. (66 miles) of road operated, she had 700 freight cars as compared to 2,200 in Great Britain or 843 in France or 950 in Germany.

Russia did, however, make heroic efforts to overcome this handicap, and this is a fact which is not being made known by the new government, occupied in placing all the failures of the past at the door of the old bureaucracy. Under the old regime, Russia stood untold suffering and dealt many hard blows, such as that of last summer along the Austrian front when she took over 300,000 prisoners. Under the old regime she did much to try to repair the faulty transportation system, as evinced by purchases of material for new lines in the United States, by the employment of French, English, Japanese and Italian railway and construction engineers. Plans were laid for many new branches of railway, and some hundreds of miles of new lines were actually laid and put into operation. But while these efforts were under way, the discouragements of the war and the conviction that it could not be won, that these technical handicaps could not be overcome gave force to the peace offers of Germany. The latter's agents during the past winter succeeded in paralyzing for weeks at a time the railway feeders leading to the wheat country north of Odessa and thereby induced the big city populations to start food riots. Then came the downfall of the old regime. As late as last September the effort of Russia to reorganize her transportation system was shown in the notice that 12,000,000 rubles has been set aside for the establishment of railway technical and training schools; 70,000,000 rubles for the extension of supply material plants already in operation, and 350,000,000 rubles were asked for as an extraordinary expenditure for new railway lines. The minister of railways as late as this January called attention to the fact that new funds were necessary to increase the rolling stock of the country, which he stated had been yearly increased since the war by 30,000 freight cars and 1,300 locomotives. At the same time he placed 40,000,000 rubles at the disposal of private supply plants as an advance of capital. But these measures came too late.

Among the several new railway projects announced as begun by the former Russian minister of transportation was that of last September regarding a branch line in Crimea, whence the Czar Nicholas has retired. The branch was to connect Sebastopol, Yalta and Alouchta.

Railway reports also indicated a serious effort on the part of Central Empire agents to destroy bridges and otherwise interfere with transportation. Last November reports from Harbin, at the eastern end of the Trans-Siberian railway, occupied in transporting Japanese and American supplies, related the discovery of Germans disguised as Chinese in the passenger coaches. The conductor saw men looking out the window as the train was crossing the Nonna river, two miles west of Harbin. Since all the bridges of this great trunk line were being watched and guarded, the conductor pulled off the cap of one of the passengers and thus led to the finding of six Germans on the train armed with dynamite.

Putting on the Screws in England, France and Italy

As a matter of truth, it must be stated that the Germans have been the most active in limiting the use of their railways to military operations, reducing their use by commerce and forcing commerce whenever possible to use the canals

and waterways. In the countries governed by the Entente, these tendencies have not worked out so smoothly. The commercial elements of the country, the chambers of commerce and so forth, have been continually working to force the governments to let them carry on their business, and the railroads themselves have been trying to keep up their earnings by the handling of as much freight and passenger traffic as possible.

The recent readjustments of tariffs is making up somewhat for the loss of civil traffic. In Austria-Hungary, freight charges have been raised 30 per cent and passenger charges 8 per cent; in France, both 15 per cent; in Italy, freight 10 to 15 per cent and passenger charges 5 per cent on third class, 10 per cent on second class and 20 per cent on first class; in Russia, both 20 to 30 per cent. The neutral countries have also increased their tariffs: Holland by 10 to 20 per cent; Sweden, freight 20 per cent, passenger 10 per cent; Norway, 20 per cent on freight and 10 per cent on passenger. The increased cost of coal, of labor and the general cheapening of money due to high prices of materials and speculation are some of the reasons making necessary these higher charges, other than the purely military one of reducing traffic.

Regarding the suppression of the liberty of commercial shipments, French Minister of Transportation Herriot made this statement: "Great Britain has courageously cut down her imports and we must do the same. Only the other day I saw in one of our ports a cargo of bananas being discharged when we lacked labor to discharge steel from another ship. I am asked to reduce the passenger trains. Already the daily mileage of trains in France has been reduced 33 per cent, beginning with February 1, 1917. We are now below the train reduction that existed during the period of our first mobilization of troops at the beginning of the war. We have economized in runs by establishing local trains between important points which operate practically as switch trains, being constantly on duty. What we need is a continual watch, too, on lines that have not been thoroughly repaired for two years. Above all, I personally need absolute authority to continue my work. There must be no reserve, or else I shall resume my place as a private citizen."

Minister Herriot is a man of undoubted capacity and worth, and really one of the big men that the war has developed in France. His words indicate the multitude of difficulties that beset the transportation situation. Every hand is lifted against the man in charge of the railroads, complaints are made by the minister of agriculture that the country will starve for want of cars to carry food to feed the population, by the minister of war that the armies will be defeated if freights and troops are not handled faster, by agents of the speculators in all classes of goods that they are unable to secure car space, by the wine growers that their crops are not being moved.

In Italy where high prices for food in the cities have caused discontent at times, though never to the same extent as in Moscow or Petrograd, on demand of the national food commission, the railroads established freight zones, being ordered to move at all times food stuffs to certain centers, but not to move them outside of the prescribed districts, which are 10 in number. By this measure it is hoped to secure an even and regular food supply to the entire population and prevent the accumulation of it in any one center, as happened in the case of storing eggs last winter when Milan had the better part of the supply for the entire season, held by the speculators.

An example of the way limited transportation produces high prices and leads to speculation and perhaps rioting was shown this winter in connection with the French wine crop. Wine is a table food in France, just as much as potatoes or steak or bread. Since the war it has been very bad, freely watered, and high-priced, particularly in Paris and other cities. This wine is moved in tank cars not unlike those familiar to Americans. These cars belong to private companies and not to the railroads. There are 8,000 of them, but their owners were unable to get them moved, and meanwhile the wine merchants in the cities, seeing the non-arrival of the supply, shot up prices. The minister of transportation investigated and found that 3,500 cars had been taken over by the army, while others were in bad condition. He fixed a uniform price for handling the remaining cars, ordered that station masters accept and move the freight, including large quantities of wine brought over the Mediterranean from the French African colonies, and thereupon the wine crisis was overcome.

Other high prices of which the civilian population may complain, though traceable to the transportation situation, must continue to the end of the war. Thus, in Rome this winter there has been a piano and furniture "crisis." During the war Rome has become the home of many Italian families of military and naval officers brought there by war duties in the ministries and in the new war factories. They have had to rent apartments and start new households. As the railroads will not accept furniture as freight, they have been compelled to buy other furniture, with the result that prices on new furniture have gone up and even old furniture is selling at the prices of new.

Following the general reduction in through freights and expresses, a New York business man in Italy on business, but wishing to go home via the Spanish line from Cadiz, in view of the submarine danger to unneutral ships, found that he would have to change trains three times between Rome and Marseilles, France, and five times between that city and Cadiz. Therefore, he reluctantly went by way of Paris, nearly double the distance.

How Germany is Cutting Down

Instead of 2,000 trains daily Berlin, according to recent information, now has about 900. This fact gives some conception of what Germany is doing as a matter of military necessity. Her abundant coal supply is diminishing by lack of labor to work her mines, but lack of oil and grease is ruining her car axles or preventing the use of all her cars. Her Roumanian expedition last fall did not come up to expectations in regard to oil yields. One of her present expedients is to send her cars to Switzerland and have them oiled and greased there. As her traffic over that frontier averages 500 cars a day, it is estimated, that allowing two or three pounds per set of car wheels, she thus obtains daily about a ton of the precious axle grease.

The railway situation pinched so sharply in Germany lately that, after having led the other nations as usual in their reductions of trains for civil use, further plans have been presented and approved by the special railway commission of the Reichstag regulating the shipment of objects of luxury or of unnecessary travel. The express or through trains have taken on third-class passengers as in Italy and France and are made to handle a certain amount of local traffic, the local trains having been cut to the minimum. Many months ago the local trains on the branch or secondary lines, operating in country districts with no important terminals, were taken off for the most part. In order to keep freight trains moving, prisoners of war, for the most part Russians, are employed at stations to unload and load freight. This freight has been limited largely to agricultural products, which, however, are none too plentiful, and to the usual abundance of war supplies of every description. These measures have reduced the need for a large amount of rolling stock. As previously stated, in the early part of the war Germany profited by taking over the cars remaining in her hands after the invasion of Belgium, and these cars are now seen in many quarters of the Empire, even as far south as Bulgaria. The cars still have the Belgian marks on them, with the Imperial eagle and cipher added.

A man who was at the distributing station of Cologne, on

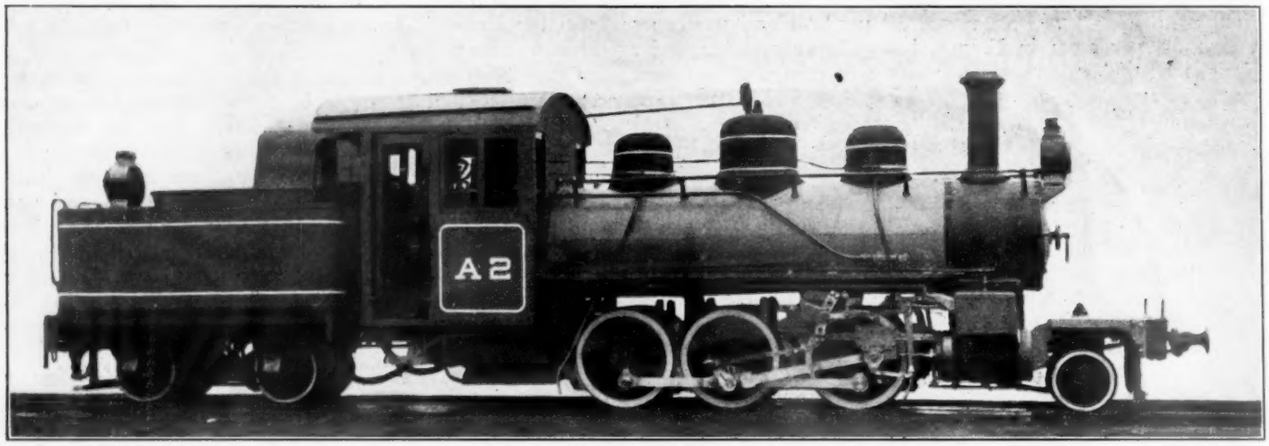
the Rhine, said recently: "The river seemed to have been itself mobilized. As far as I could see were long lines of cargo floats pulled by tugs, laden with coal or stacked with shell boxes and trench machinery. These lines of floats moved with the order of a military camp, almost as if on dress parade. Along the docks of the city worked thousands of prisoners, French and English, but mostly Russian, loading and unloading the floats as they came alongside. They worked silently, without a cry or a word. The docks themselves were heaped with war materials, shells, shells, shells, mostly 105's, hand grenades, machine guns, cartridge boxes, torpedoes for submarines.

"The freight cars that were drawn up and loaded, always heavily, pulled out without whistling; merely a signal from the station master and they gave way to a new train. The absence of human noise, of cheerful talk, grows on one in Germany. One feels all the time as if he were attending a succession of funerals. How Germany transports the little milk she has, I can't imagine, for I did not see a single milk can. I remembered this fact when I got over the frontier into Switzerland. There all I seemed to be able to see were milk cans and roads filled with automobiles. At the Swiss frontier station I ate butter with cream and sugar, just like candy. The station, noisy and crowded with fat people, with fine, brightly painted coaches, seemed to belong to another world."

WAR LOCOMOTIVES BUILT IN AMERICA

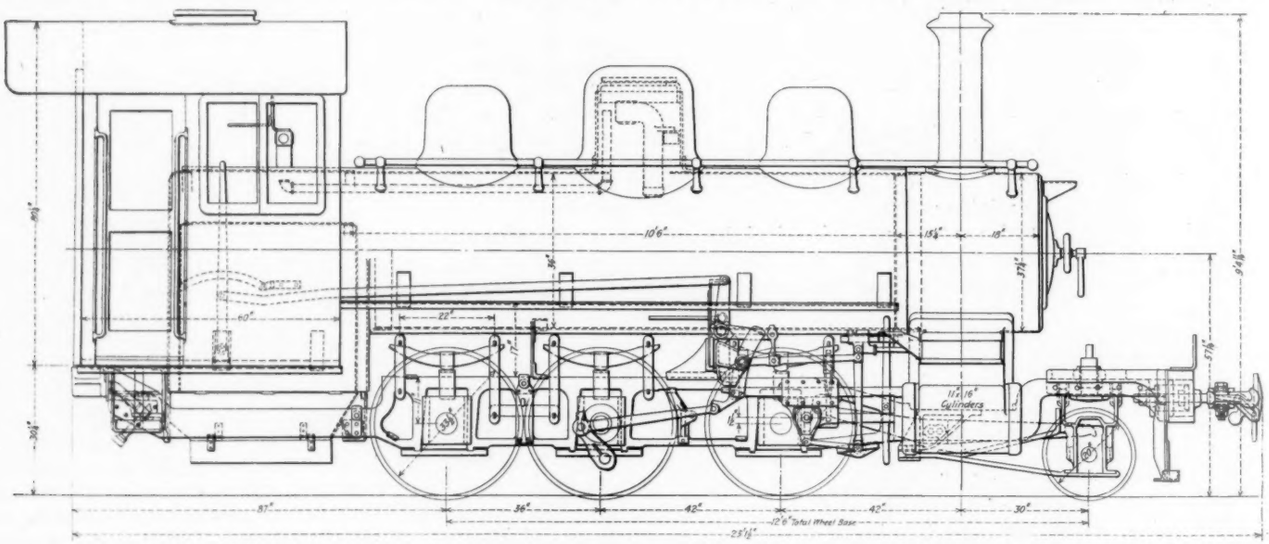
Among the many locomotives built in this country for the warring nations in Europe, those shown in the illustrations are of particular interest, since they follow so closely American standards in construction. They were built by the American Locomotive Company.

The British locomotive, built for the British War Office, is a tank engine, having a 2-6-2 wheel arrangement. It has a driving wheel 27 in. in diameter, carries a boiler pressure of 175 lb. and burns soft coal for fuel. It was designed to be used on 1 ft. 11⅝ in. gage tracks. The cylinders are 9 in. in diameter and have a 14-in. stroke. The maximum tractive effort exerted by the locomotive is 6,250 lb., which with a weight on drivers of 23,400 lb. gives a factor of adhesion of 3.74.



Small Wheeled Mogul Locomotive for the Russian State Railways

The boiler is 32 in. in diameter at the first course. There are 54 two-in. tubes, providing a heating surface of 237 sq. ft., the tubes being 8 ft. 6 in. long. The firebox is 30 in. by 25 in. and has a heating surface of 27 sq. ft. The grate area is 5.4 sq. ft. The locomotives burn soft coal, space being provided for ¾ English tons. The tanks have a capacity of 395 Imperial gallons. This locomotive has a rigid wheel base of 5 ft. 6 in. and a total wheel base of 16 ft. 6 in. With a low center of gravity and long wheel base it is especially adapted for service on rough tracks,

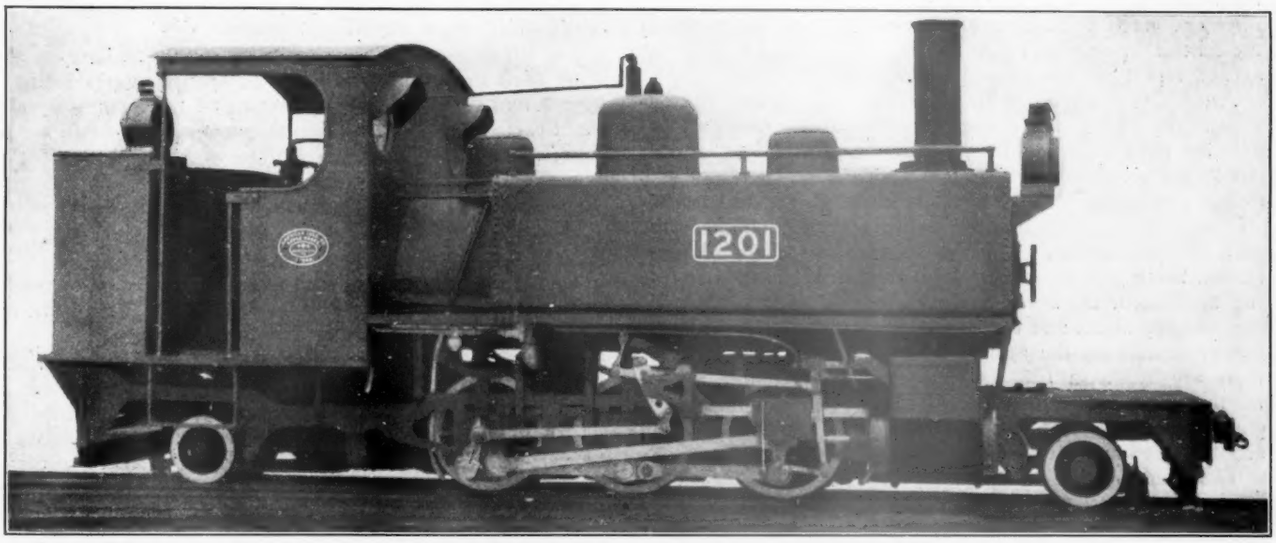


Elevation of the Russian Locomotive

such as are likely to be encountered in the service of the war.

The locomotive for the Russian Government State Railways is equipped with bar frames and has the Walschaert valve gear. It is equalized in a manner similar to that used in American practice, the front truck being equalized with the leading pair of drivers by a long longitudinal equalizer. This locomotive has a total weight of 38,200 lb. with 34,740 lb. on drivers, and 3,460 lb. on the truck. The cylinders are 11 in. in diameter and have a 16-in stroke. The diameter of the driving wheels is only 33½ in. which with a boiler pressure of 165 lb. gives a maximum tractive effort of 8,100 lb. The engine is built for a track having a 2 ft. 5½ in. gage.

The boiler is of a straight type, the first course being 36½ in. in diameter. There are 85 tubes of 2 in. diameter which are 10 ft. 6 in. long. They provide a heating surface of 463 sq. ft., which together with a 40½ in. by 33 in. firebox with 41 sq. ft. heating surface, gives a total heating surface of 504 sq. ft. The grate area is 9.3 sq. ft. This engine has a rigid wheel base of 6 ft. 6 in. and a total wheel base of 12 ft. 6 in. This engine is designed to consume soft coal and the tender, which is of a four-wheel type, has a capacity of 1½ tons of fuel and 600 gal. of water.



Narrow Gage Locomotive Built for the British Government

Saving Labor in the Accounting Department

Roads Are Substituting Women and Various Labor Saving Machines Which Women Can Run for Men

A VERY large number of the men who are employed in railroad auditors' offices are of military age and are liable to draft. Unlike many other classes of railroad work, the audit office clerk's work is not skilled labor and the clerk, therefore, will not be exempt from draft because his work is necessary to the smooth running of the transportation machine of the country. For this reason a great many accounting officers are casting about for ways and means by which the work in the auditing offices can be carried on with the least interference when a certain proportion of the male employees are called out. It is, therefore, particularly interesting at this time to make a survey in a general way of the labor saving machines that are used in auditors' offices and especially to study the feasibility of having such machines operated by women.

The principal labor saving machines that are in use are the Hollerith machine and the Powers machine, the comptometer and machines like it and typewriters with various attachments for adding figures, etc. The Hollerith machine and the comptometer have been in use in railroad accounting offices for many years. There are roads that have been using girl operators for both of these machines, but a large number of roads have been using young men for the Hollerith machine. The Hollerith machine not only requires much skill in punching the cards but also requires the operator on some parts of the work to be on his feet a good part of the time. It has probably been these two considerations which have led to the use of men rather than girls as operators. The comptometer requires a great deal of skill and a certain amount of muscular effort. The Powers machine, which can be used for the same kind of work as the Hollerith machine, has been in use a comparatively short time. This is true also of the other machines which can be used to do the same work as the comptometer, but are run by electricity and require much less muscular effort than the comptometer. The typewriters with the adding attachments are a comparatively recent development. Probably the Delaware, Lackawanna & Western has been the pioneer in the use of these machines in freight and ticket auditing offices. The following is a description of how these machines are used in the office of the auditor of freight and ticket accounts:

Waybills are reported and sent in daily by the agents. When they are received in the auditor's office, they are sorted in road order and are sent to the comptometer bureau for the checking or revision of extensions and then to the rate clerks for checking of rates and classifications. These clerks issue any necessary "Correction Notices," etc.

The waybills are then passed to clerks and are sorted in station and road order with proper audit office settlement abstracts for the operators. The sorting clerks also make

notations of anything unusual that might confuse the machine operators in abstracting the waybills. The waybills are written up, on the adding and subtracting typewriter; the size of the station governs the number of set-ups or times during the month the waybills from the stations are written up on the abstracts. This is determined by the size of the station and the volume of billing. For example: the billing for five days might be given to an operator to write up, and the totals of the control, or tally sheets, would then be checked against the agent's report for the five days covering these bills.

After all of the waybills have been abstracted, the abstracts are added in the comptometer bureau; the percentages are put on them by the interline department and worked out by the comptometer operators. The same operators who do the abstracting write the recaps and division statements.

The local waybills received are worked out on the same plan as the interline. The waybills are sorted according to station movement, shipments from station A to station B being abstracted, the entries manifolding through to the control, or tally sheet, and the total of the control, or tally sheet, balancing against the agent's local received report. Where there are less than 125 waybills to abstract from a station for the month, the control sheet is used and the totals shown on each abstract; and recapitulation of these abstracts made and balanced against the agent's received reports.

The commodity is written and shown on the abstracts of local waybills received. Comptometer operators segregate the revenue for each commodity writing it on the abstract with the commodity number and a card is punched on the Hollerith machine for each commodity (not for each waybill), to secure the revenue by commodities. This same method of getting the revenues by commodities from the interline abstracts, both forwarded and received, is used.

There is a very material saving by using Remington adding and subtracting typewriters for balancing and obtaining the commodity revenue from the abstracts instead of waybills, as formerly. The local abstracts are then assorted into forwarding stations and a recapitulation made of each forwarding station, thereby obtaining a total of the freight, advances and prepaid received on a forwarding station basis. As agents render daily reports of local waybills issued in numerical order, regardless of destination, it is a very simple operation to check the abstracts prepared on the Remington adding and subtracting typewriters against these reports to prove the advances and prepaids forwarded with the advances and prepaids received and to obtain the record of waybills in transit, etc.

In the preparation of the "Correction account on interline waybills received from foreign lines," the typewriter machine is equipped with 18 vertical totalizers and a cross-totalizer, adding the "Weight," "Freight," "Advances," "Prepaid," and proportions "As Settled" and "As Corrected." In writing this report the freight "As Settled" goes into the cross-totalizer and the proportions are subtracted and the totalizer cleared as a proof and freight "As Corrected" is subtracted in the cross-totalizer and the proportions added to clear the cross-totalizer as a proof.

In order to get a proof of the "Correction," the operator then returns the carriage, writes the "Freight" a second time over the figures formerly written; to this adds the "Advances" and subtracts the "Prepaid" in the cross-totalizer for the "As Settled" group, subtracts the "Freight," subtracts the "Advances," adds the "Prepaid" in the "As Corrected" group, and the balance shown in the cross-totalizer is either the debit or credit to agent for the "Settlement," the debit adding in the cross-totalizer and the credit subtracting in the cross-totalizer, thus giving a proof of the correction entry—the totalizer clearing when debit or credit is written. In writing totals the amount in two freight totalizers is halved and written "twice."

The audit of the Interline forwarded is practically handled in the same manner, but it is not necessary to use the Remington-Wahl machines in preparing abstracts, as they are furnished by the auditor of the carrier receiving the freight. When these abstracts are received in the office, they are assorted into forwarding station movements and reconciled with agents' daily forwarded reports of interline waybills issued to prove the advances and prepaids and also to obtain the record of interline waybills in transit.

The Remington adding and subtracting typewriters are also being used in the preparation of "Miscellaneous Earnings." Agents make daily or weekly reports of miscellaneous earnings tickets issued. These tickets, when received with the reports, are assorted into kinds of service and by the use of Remington machines the total earnings of each kind of service is obtained for each station and for the entire system, the statements being proved with the agents' daily or weekly reports by the adders.

There are other types of adding and subtracting devices for typewriters than those used by the Lackawanna, the principal ones being the Elliott Fisher and the Underwood.

It will be noted that the Lackawanna uses the typewriter adding and subtracting machines for the entire audit. After the audit has been made, Hollerith cards are punched for the commodities as shown on the abstracts of waybills and the various freight statistics are compiled from these cards. This method contrasts with that used by the New York Central where the information on the waybill is punched on the Hollerith cards as soon as the bill is received in the auditor's office, a second card being punched for corrections. The test of which of these methods is the more economical is a matter largely of individual judgment and observation. It is a fact acknowledged by most accounting officers that there are a great many mistakes made in the auditor's office and that there is a really large waste of labor in tracing through these mistakes. If the Delaware, Lackawanna & Western system actually eliminates a very considerable proportion of the mistakes which would under some other system occur within the audit office itself, it is one which should deserve the attention of all accounting officers. One thing, however, may be said safely: the Delaware, Lackawanna & Western is finding it feasible and economical to use girls both in the comptometer bureau and on the adding and subtracting typewriters, and believes from the tests that have been made that the use of the adding and subtracting typewriters in agents' offices on the road is proving economical of the agents' time.

Simplifying Maintenance of Way Accounts

In England, as a war measure, the government has suspended the requirements for reporting railroad accounts and has permitted the roads to use a very much condensed and simplified system. It might well be that the Interstate Commerce Commission could follow the English government's example and permit a very much condensed and simplified report; and especially is this true of maintenance of way expenses and transportation expenses. There are 35 primary accounts under the present maintenance of way accounts as prescribed by the Interstate Commerce Commission. An order of the Interstate Commerce Commission could be made permitting the grouping of these accounts together, and reporting in a lump sum a number of them so that there would be only eight accounts, with a large saving of labor in the accounting offices and almost no disturbance of comparisons. These eight accounts might be as follows: Track maintenance, applying track material—labor; applying track material—material; roadway; structures—labor; structures—material; miscellaneous—labor; miscellaneous—material. The present 63 accounts under transportation expenses might well be combined into the following: Superintendence, train movement, station service, engine house expenses, fuel, other locomotive and train supplies, yard service, road engine and trainmen, casualties, miscellaneous, joint facilities.

Passenger Train Economy Without Impairing Service

Duplication of Service Should be Reduced. Unnecessary Passenger Service is Wasting Needed Facilities

"WE must get the business" has for so long been the slogan of American railroads that it is like changing the habits of a lifetime for many railroad officers to consider taking off passenger trains which are getting a share of competitive business. Competition in passenger business dates back to before the first railroad was built. There was competition in stage coach service before the first steam engine hauled a passenger train. With the exception of main line mileage of a comparatively few roads, the track capacity of American railroads, excluding terminal facilities, is in normal times and under normal conditions of freight movement ample to take care of more business than is being handled. If, therefore, a competing road puts on a passenger train leaving a city at a certain time, its competitors, if they are to get a slice of this particular passenger business, must also put on passenger trains running approximately on the same schedule and leaving at about the same time. For instance, between Buffalo and Pittsburgh the Pennsylvania, the Buffalo, Rochester & Pittsburgh and the New York Central-Pittsburgh & Lake Erie all compete for passenger business. The New York Central has a train leaving Buffalo at 9 a. m. and arriving at 3 p. m.; the Buffalo, Rochester & Pittsburgh a train leaving at 9:30 a.m. and arriving at 6:20 p. m., and the Pennsylvania a train leaving at 9:15 a. m. and arriving at 5:45 p. m. So far as through service is concerned, the public would apparently be just as well served if one of these three trains was eliminated. It is not meant to suggest that one-third of this entire service is superfluous, but this is used as an example to show the kind of schedules which competition is likely to build up. Take another example: The Chicago & North Western has a train leaving St. Paul for Duluth at 7:45 a. m. and arriving at 3:35 p. m.; the Northern Pacific has a train leaving at 8:10 a. m. and arriving at 2:05 p. m., and the Great Northern has a train leaving at 9 a. m. and arriving at 2:25 p. m.

A list has been compiled, which is printed herewith, showing express train service between a few of the principal pairs of cities where there is competition between two or more railroads. Each example cited would have to be studied by experts thoroughly familiar with local conditions, and entirely unprejudiced, to determine what trains could be taken off without actually impairing the service rendered by all the railroads to the public. Notwithstanding, however, that each case would require special and careful study, it is obvious that there is presented here demonstration of a waste of railroad facilities which should not be permitted to continue during the war.

The Executive Committee of the Special Committee on National Defense of the American Railway Association, which is often spoken of as the Railroads' War Board, has been giving considerable thought and attention to this unnecessary duplication of passenger service. The best results will not be secured, however, unless the groups of railways directly engaged in rendering unnecessary service should themselves get together and work out an equitable scheme by which one road may run a train, for example, at nine o'clock, and its competitor will run none at that time but one at noon, while the first road will cut out its noon service.

The eastern roads are as a whole more nearly being worked, even under normal times, to their full capacity than are most of the western roads. An overload such as is now being placed on railroad facilities in this country probably can be carried by a road earning on an average less than $10,000 a year a mile, and the additional revenue will more than offset the additional expense, but on roads being worked nearly up to capacity under normal times a large percentage of increased business will often prove profitable for the first five or six months and then the rising tide of expenses due to congestion, delays, overtime, etc., will more than eat up the additional revenue. This probably explains why eastern and especially trunk line railroad managements can see more readily the evils of wasting transportation facilities than can some of the western and southern lines on which the traffic, even under the present abnormal conditions, is not pressing unbearably on facilities; but the waste is there,

CINCINNATI TO NEW ORLEANS

Cin., New Orleans & Tex. Pac.	*Louisville & Nashville*
8 p.m. ar. 9:05 p.m.	10:30 p.m. ar. 7:05 a.m.
8 a.m. ar. 9:40 a.m.	6:15 p.m. ar. 8:55 p.m.

CHICAGO TO LOUISVILLE

Chesapeake & Ohio	*Chicago, Indianapolis & Louisville*
5:35 p.m. ar. 10:55 a.m.	8:30 a.m. ar. 7:35 p.m.
	9 p.m. ar. 7:30 a.m.
Cleve., Cin., Chic. & St. Louis	*Pennsylvania*
8:55 a.m. ar. 7:15 p.m.	9:30 a.m. ar. 6:35 p.m.
9 p.m. ar. 7:30 a.m.	9:20 p.m. ar. 7:10 a.m.
	11:55 p.m. ar. 8:40 a.m.

ST. PAUL TO WINNIPEG

Great Northern	*Northern Pacific*
7 p.m. ar. 3:35 p.m.	8:20 a.m. ar. 11:20 p.m.
5:35 p.m. ar. 8:40 a.m.	

Minn., St. Paul & Sault Ste. Marie

5 p.m. ar. 8:05 a.m.

CHICAGO TO KANSAS CITY

Atchison, Topeka & Santa Fe	*Chicago, Burlington & Quincy*
2:15 a.m. ar. 3:55 p.m.	6:10 p.m. ar. 8 a.m.
9:50 a.m. ar. 9:20 p.m.	
4:45 p.m. ar. 3 a.m.	
6 p.m. ar. 7:30 a.m.	
10:30 p.m. ar. 10:30 a.m.	
Chicago Great Western	*Chicago, Milwaukee & St. Paul*
11:30 p.m. ar. 8:20 p.m.	6 p.m. ar. 8:30 a.m.
8 a.m. ar. 7:45 a.m.	
6:30 p.m. ar. 3:35 p.m.	

Chicago & Alton

11 p.m. ar. 12:30 noon
6:30 p.m. ar. 8:20 a.m.

CHICAGO TO OMAHA

Chicago & North Western	*Chicago, Burlington & Quincy*
11:20 p.m. ar. 3:30 p.m.	11 p.m. ar. 3:55 p.m.
10 p.m. ar. 11:40 a.m.	6:15 p.m. ar. 8 a.m.
9:40 p.m. ar. 10:15 a.m.	10:05 a.m. ar. 12:01 noon
6:05 p.m. ar. 7:20 a.m.	5:30 p.m. ar. 7 a.m.
10:45 a.m. ar. 12:10 night	
Chicago, Milwaukee & St. Paul	*Chicago, Rock Island & Pacific*
6:05 p.m. ar. 11:50 a.m.	10 p.m. ar. 1:30 p.m.
10:05 p.m. ar. 11:05 a.m.	6 p.m. ar. 8:15 a.m.
	10 a.m. ar. 10:45 p.m.

Illinois Central

11:30 p.m. ar. 5:30 p.m.
5:30 p.m. ar. 8:20 a.m.

CHICAGO TO ST. LOUIS

Wabash	*Chicago & Eastern Illinois*
12:02 noon ar. 7:57 p.m.	11:55 a.m. ar. 7:49 p.m.
9:17 p.m. ar. 7:05 a.m.	9:05 p.m. ar. 6:55 a.m.
11:55 p.m. ar. 7:42 a.m.	11:59 p.m. ar. 7:40 a.m.
Chicago & Alton	*Illinois Central*
10:15 a.m. ar. 6 p.m.	10:02 a.m. ar. 5:46 p.m.
12:01 noon ar. 7:40 p.m.	10:30 p.m. ar. 7:48 a.m.
9 p.m. ar. 7:01 a.m.	
11:59 p.m. ar. 7:49 a.m.	

CHICAGO TO CINCINNATI

Chesapeake & Ohio of Indiana	*Chicago, Indianapolis & Louisville*
11:45 a.m. ar. 8:45 p.m.	9:20 a.m. ar. 5:55 p.m.
	12 noon ar. 8:30 p.m.
	11:40 p.m. ar. 8:10 a.m.
Cleve., Cin., Chic. & St. Louis	*Pennsylvania Lines West*
8:55 a.m. ar. 6 p.m.	9:30 a.m. ar. 6 p.m.
12:55 noon ar. 9 p.m.	9:20 p.m. ar. 7:12 a.m.
9 p.m. ar. 7 a.m.	11:55 p.m. ar. 7:35 a.m.
10:05 p.m. ar. 6:30 a.m.	
11:25 p.m. ar. 7:25 a.m.	

nevertheless. It is quite conceivable that there will be in the comparatively near future some arrangement for pooling railroad equipment, or at least having the allotment of it under the supervision of a central committee at Washington. In such a case a wasted locomotive on the Atchison, Topeka & Santa Fe would be just as much wasted for the roads as a whole as one on the Erie. While it is true that the pressure at present is on freight service and not on passenger service, a reduction in passenger service would help greatly to reduce the pressure on freight service. It is not only that there is a locomotive released—and in express passenger service, such as is shown on our table of competitive service, this locomotive in many cases is a Pacific or other heavy type locomotive which could be used in expedited freight service—but the running of each one of these fast passenger trains means delay to freight trains. It means also the burning of fuel which could be conserved for freight service or for manufactures and domestic use; it means the use of a train crew which could be used in freight service; it means the use of train despatcher's time, and of a great many other elements which can be employed in either the transportation of freight or passengers.

While it is true that the reduction in passenger service will have its greatest usefulness in increasing facilities for freight service, it must be remembered that when the mobilization of an army of 500,000 men begins, passenger cars and passenger locomotives are going to be needed in great quantities for purely military service. A field army consists of 80,000 men, and to move it requires 6,229 cars, made up into 366 trains, which, of course, means 366 locomotives. Of these 6,229, 2,115 cars are passenger cars and 385 cars are baggage cars. If the railroads wait until actually called upon to begin to move the first army of 80,000 regular passenger service will almost certainly be crippled, at least for a while. If, however, the roads begin now cutting down waste, conserving passenger cars and passenger locomotives, taking off trains that can best be spared, when the time comes to move the first new army no drastic derangement of passenger schedules will have to be made, and the roads themselves will probably find that the great burden of providing transportation for mobilization will be carried more easily and smoothly than it will be if the roads wait until the last minute to begin to provide transportation facilities for the movement of troops.

It is not meant to imply that all of this situation is not being studied with care and that the routing of troops is not all being worked out on a thoroughly scientific basis. The point made here is that in addition to immediately and greatly helping the freight situation, the reduction of competitive passenger service will very much simplify the mobilization of large bodies of troops when this becomes necessary.

Canadian Experience

The extent to which passenger service has been cut down in Canada is indicated by the fact that the Canadian Northern reduced its passenger train mileage on the lines east of Port Arthur by over 50,000 passenger train miles per month beginning with December, 1916. The Canadian Pacific and the Grand Trunk have also made reductions. Out of 41 trains running on these two roads between Hamilton and Toronto, 16 were taken off in January. The Canadian Railway Commission has co-operated loyally with the Canadian roads by permitting or ordering reductions of unnecessary passenger service. The elimination of club cars, the lengthening of passenger schedules and the converting of local passenger service into mixed service are all being considered and will all probably be adopted to a greater or less extent.

England has had somewhat the same situation as regards competing trains on its north and south lines from London, as has the United States on its lines between New York and Chicago, Chicago and St. Louis, etc. After the lines went under the control of the government at the beginning of the war there was a cessation of active competition, but the pressure of public opinion kept a certain number of trains operating that really left a duplication of service. Prior to January, 1917, however, new schedules were adopted which cut off the duplication of service. Train schedules were

Chicago to San Francisco

Chicago & North Western, Union Pacific, Southern Pacific

Lv. 7:00 p.m.	Ar. 10:10 a.m. (3rd day)
10:00 p.m.	7:50 p.m. (3rd day)
11:20 p.m.	9:30 a.m. (4th day)

Atchison, Topeka & Santa Fe

Lv. 10:30 p.m.	Ar. 8:00 a.m. (4th day)
10:30 p.m.	5:45 p.m. (4th day)
8:05 p.m.	10:00 p.m. (3rd day)

Chicago, Rock Island & Pacific, Denver & Rio Grande, Northern Pacific

Lv. 10:00 p.m. Ar. 6:30 p.m. (4th day)

Chicago to Los Angeles

Chicago & North Western, Union Pacific, Los Angeles & Salt Lake

Lv. 10:00 p.m.	Ar. 4:30 p.m. (3rd day)
10:45 a.m.	2:30 p.m. (3rd day)

Atchison, Topeka & Santa Fe

Lv. 10:30 p.m.	Ar. 7:50 p.m. (3rd day)
10:30 p.m.	8:45 a.m. (4th day)
9:50 a.m.	7:10 a.m. (3rd day)
8:05 p.m.	2:40 p.m. (3rd day)

Chicago, Rock Island & Pacific and Southern Pacific

Lv. 9:00 a.m.	Ar. 7:15 a.m. (3rd day)
8:05 p.m.	2:30 p.m. (3rd day)

Chicago to New York

Pennsylvania		*Erie*	
Lv. 8:45 a.m.	Ar. 8:57 p.m.	Lv. 11:00 a.m.	Ar. 4:02 p.m.
10:30 a.m.	9:28 p.m.		
12:40 noon	9:40 a.m.	11:10 p.m.	7:15 a.m. (2d morning)
3:15 p.m.	8:13 p.m.		
5:30 p.m.	5:28 p.m.		
8:00 p.m.	7:26 p.m.		
8:15 p.m.	7:26 p.m.		
11:45 p.m.	11:30 p.m.		

Baltimore & Ohio

Lv. 5:45 p.m.	Ar. 10:50 p.m.
10:00 p.m.	7:00 a.m. (2nd morning)
8:25 a.m.	1:15 p.m.
10:45 a.m.	2:35 p.m.

Lehigh Valley & Michigan Central		*Lehigh Valley & Grand Trunk*	
Lv. 5:40 p.m.	Ar. 8:23 p.m.	Lv. 12:10 noon	Ar. 4:45 p.m.
9:05 a.m.	10:02 a.m.	10:45 p.m.	7:57 a.m. (2nd morning)

Delaware, Lackawanna & Western

Michigan Central No. 6.....	Lv. 5:40 p.m.	Ar. 7:30 p.m.
Michigan Central No. 10.....	12:05 night	7:05 a.m.
Michigan Central No. 14.....	9:05 a.m.	10:55 a.m.

(No. 6 also by Wabash, New York, Chicago & St. Louis, No. 10, same.)

New York Central		*New York Central & Michigan Central*	
Lv. 2:50 a.m.	Ar. 7:03 a.m.	Lv. 12:05 night	Ar. 7.03 a.m. (2nd morning)
8:25 a.m.	8:00 a.m.		9:00 a.m.
10:25 a.m.	9:21 a.m.	9:05 a.m.	3:30 p.m.
10:30 a.m.	3:30 p.m.	10:30 a.m.	5:30 p.m.
12:40 noon	9:40 a.m.	5:40 p.m.	8:45 p.m.
1:40 p.m.	3:45 p.m.	3:00 p.m.	
3:15 p.m.	8:45 p.m.	*New York, Chicago & St. Louis*	
5:30 p.m.	5:25 p.m.		
8:00 p.m.	8:00 p.m.	Lv. 9:40 p.m.	Ar. 6:25 a.m.
11:00 p.m.	10:10 p.m.	10:35 a.m.	5:05 p.m.
11:45 p.m.	5:05 a.m. (2nd morning)	2:30 p.m.	8:55 p.m.

Chicago to Indianapolis

Chicago, Indianapolis & Louisville		*Cleveland, Cincinnati, Chicago & St. Louis*	
Lv. 9:20 a.m.	Ar. 2:20 p.m.	Lv. 8:55 a.m.	Ar. 2:40 p.m.
12:00 noon	5:00 p.m.	12:55 noon	6:05 p.m.
5:30 p.m.	10:30 p.m.	9:00 p.m.	3:10 a.m.
11:40 p.m.	4:50 a.m.	10:05 p.m.	3:18 a.m.
		11:55 p.m.	5:00 a.m.

Pennsylvania

Lv. 9:30 a.m.	Ar. 3:05 p.m.
9:20 p.m.	3:30 a.m.
11:55 p.m.	5:30 a.m.

Chicago to Pittsburgh

Pennsylvania		*Baltimore & Ohio*	
Lv. 2:55 a.m.	Ar. 3:30 p.m.	Lv. 8:25 a.m.	Ar. 10:20 p.m.
8:45 a.m.	8:45 p.m.	10:45 a.m.	12:02 p.m.
10:30 a.m.	9:50 p.m.	5:45 p.m.	7:50 a.m.
12:40 noon	11:00 p.m.	10:00 p.m.	12:55 p.m.
3:15 p.m.	5:40 a.m.		
5:30 p.m.	5:30 p.m.	*New York Central and Pittsburgh & Lake Erie*	
8:00 p.m.	8:05 a.m.		
8:15 p.m.	8:20 a.m.	Lv. 8:25 a.m.	Ar. 9:30 p.m.
11:45 p.m.	10:30 a.m.	8:00 p.m.	8:55 a.m.
		11:00 p.m.	11:20 a.m.

lengthened out very considerably and it is interesting to find in most cases it was simply a slower running time fixed between stations, there being comparatively few additional stops. Except for workmen's tickets, season and traders' tickets and those on the London Underground, all passenger fares in England have been increased 50 per cent. This was done at the direction of the government and the railway companies get no additional profit therefrom. Compartments and seats can no longer be reserved; motor cars, carriages, empty hearses and other road vehicles are no longer being carried on passenger trains, and the good old English custom of not having to produce your season ticket has been discontinued. This latter reform is because of the employment of women ticket collectors to replace the inspectors who had been for years familiar with the faces of season ticket holders.

CLEVELAND TO CINCINNATI

Pennsylvania	*Cleveland, Cincinnati, Chicago & St. Louis*
8:10 a.m. ar. 5:25 p.m.	7:40 a.m. ar. 1:55 p.m.
8:45 p.m. ar. 6:30 a.m.	11:30 a.m. ar. 6 p.m.
	12:15 p.m. ar. 7:50 p.m.
	8:15 p.m. ar. 5 a.m.
	12:05 night ar. 7:15 a.m.

BALTIMORE TO WASHINGTON

Express trains only—Time 44 to 60 minutes

Baltimore & Ohio			*Pennsylvania*		
7 a.m.	1 p.m.	6:30 p.m.	6:05 a.m.	12:47 noon	5:45 p.m.
8 a.m.	2 p.m.	7:55 p.m.	6:20 a.m.	1:41 p.m.	7:15 p.m.
9 a.m.	3 p.m.	8:16 p.m.	7:38 a.m.	2:08 p.m.	7:26 p.m.
10 a.m.	4 p.m.	10:55 p.m.	8:44 a.m.	2:19 p.m.	7:40 p.m.
11 a.m.	4:56 p.m.	11:38 p.m.	9:24 a.m.	2:32 p.m.	8:12 p.m.
12:42 noon	6 p.m.		9:50 a.m.	3:23 p.m.	9:20 p.m.
			10:39 a.m.	3:40 p.m.	9:53 p.m.
			12:10 noon	4:40 p.m.	10:37 p.m.
			12:40 noon	5:30 p.m.	

PHILADELPHIA TO READING

Philadelphia & Reading	*Pennsylvania*
8:36 a.m. ar. 10:03 a.m.	9:10 a.m. ar. 10:44 a.m.
10:30 a.m. ar. 12:10 noon	4:10 p.m. ar. 5:39 p.m.
1:25 p.m. ar. 3 p.m.	6:09 p.m. ar. 7:48 p.m.
4:06 p.m. ar. 5:51 p.m.	8:10 p.m. ar. 9:57 p.m.
6:56 p.m. ar. 8:32 p.m.	
11:30 p.m. ar. 1:08 a.m.	

BUFFALO TO PITTSBURGH

Pennsylvania	*Buffalo, Rochester & Pittsburgh*
9:15 a.m. ar. 5:45 p.m.	9:30 a.m. ar. 6:20 p.m.
11:10 p.m. ar. 7:45 a.m.	10:20 p.m. ar. 7:15 a.m.

New York Central—Pittsburgh & Lake Erie

9 a.m. ar. 3 p.m.
12:25 p.m. ar. 6:55 p.m.
4:35 p.m. ar. 10:05 p.m.
11:15 p.m. ar. 6:30 a.m.

NEW YORK TO PITTSFIELD

New York Central	*New York, New Haven & Hartford*
8:50 a.m. ar. 1:36 p.m.	8:51 a.m. ar. 2:16 p.m.
3:20 p.m. ar. 8:00 p.m.	3:30 p.m. ar. 8:15 p.m.

BOSTON TO MONTREAL

Boston & Maine, C. Vt. and Grand Trunk	*Boston & Maine and Canadian Pacific*
9 a.m. ar. 8:10 p.m.	9:30 a.m. ar. 9:55 p.m.
8 p.m. ar. 7:55 a.m.	8:30 p.m. ar. 8:20 a.m.
11:30 a.m. ar. 10:15 p.m.	

Boston & Maine and Rutland

11:15 a.m. ar. 10 p.m.
7:55 p.m. ar. 7:40 a.m.

ST. PAUL TO DULUTH

Chicago & North Western	*Northern Pacific*
7:45 a.m. ar. 3:35 p.m.	8:10 a.m. ar. 2:05 p.m.
3:50 p.m. ar. 10:05 p.m.	2 p.m. ar. 7:25 p.m.
	11 p.m. ar. 6:30 a.m.

Great Northern	*Minneapolis, St. Paul & Sault Ste. Marie*
1:30 p.m. ar. 6:55 p.m.	1:30 p.m. ar. 6:55 p.m.
11:10 p.m. ar. 6:30 a.m.	11 p.m. ar. 6:30 a.m.

ST. LOUIS TO DALLAS

Missouri, Kansas & Texas	*St. Louis South Western*
6:30 p.m. ar. 12:40 noon	9:50 a.m. ar. 4:45 p.m.
9:15 a.m. ar. 7:50 a.m.	9:16 p.m. ar. 6:15 a.m. second day
9:05 p.m. ar. 7:35 p.m.	
St. Louis & San Francisco	*Missouri Pacific*
9:00 p.m. ar. 7 p.m.	6:25 p. m. ar. 12:35 noon
9:00 a.m. ar. 7:15 a.m.	
2:15 p.m. via Sapulpa, ar. 8:50 p.m.	

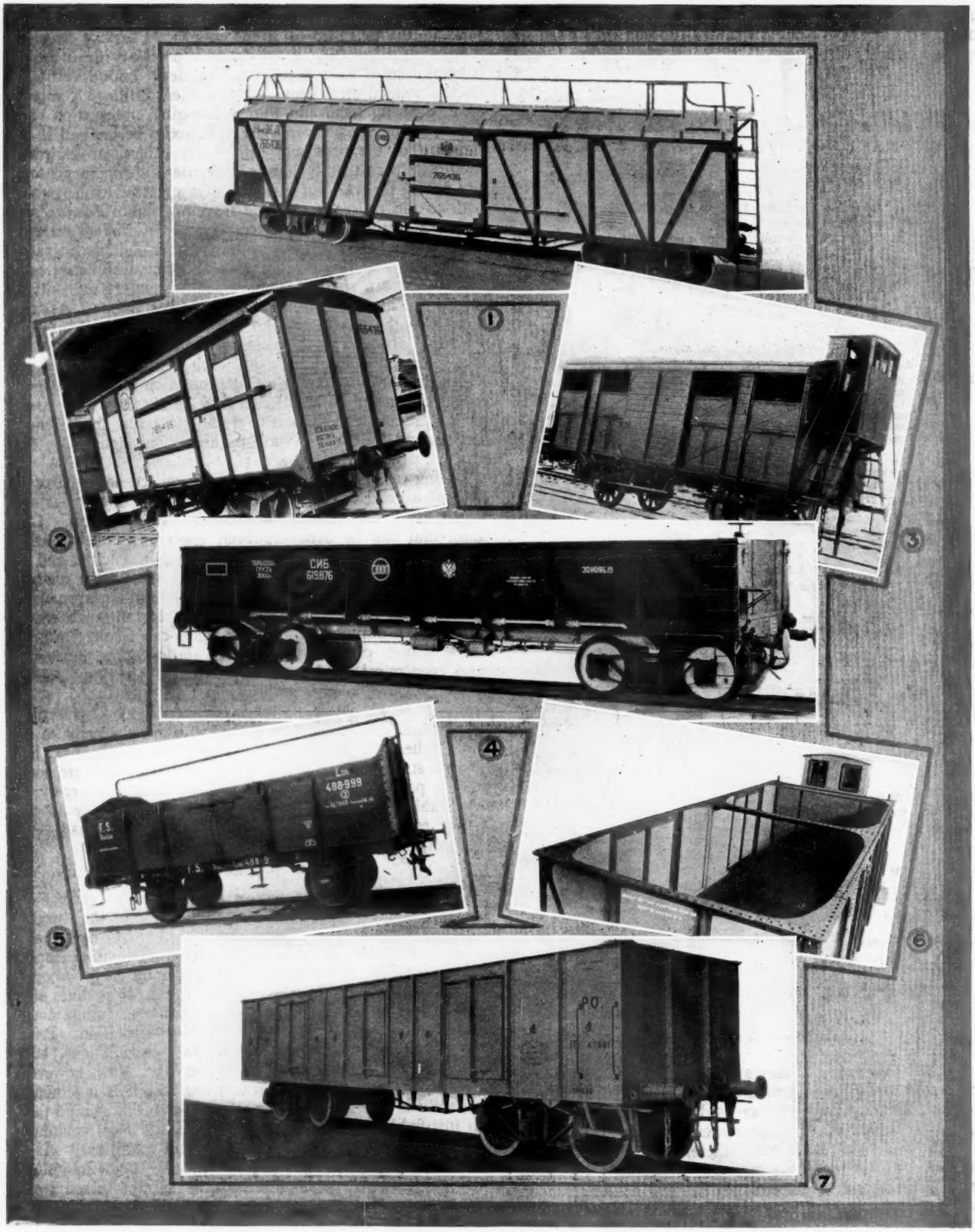
TAKING OFF CLUB AND OBSERVATION CARS

Besides the duplication of service many other effective means of competition have been developed in American passenger service. One has only to glance through the descriptions of the make-up of trains in express service to get a realization of how much not actually necessary dead weight is being hauled to each passenger carried. "Solid vestibule, electric lighted steel train, with coaches, Pullman compartment, drawing room and library lounging, observation cars, drawing room, parlor cars, etc." It would be too bad if the standard of the passenger service on American railroads should be permanently lowered because of temporary necessity during the war, but it would be of great permanent good, both to the railroads and the traveling public, if the war forced a cutting off of unnecessary weight carried on passenger trains, and then, when the pressure on railroad facilities lessened, and observation cars, lounging and library cars, etc., were again restored, that passengers getting this service should be charged a proportionate additional rate. As it is now, both the passenger who rides in a train such as that described above, and the passenger who is one of only ten passengers on a local train are each getting something for which they are not paying a fair proportion of the total passenger charges of railroads. It may be absolutely necessary during the course of the war to eliminate "frills" in passenger service, and if it is necessary no hesitation ought to be felt in asking the public to bear it.

Dining cars have for years been recognized as a source of loss to railroad companies, but for this reason alone it can hardly be urged that they should now be taken off. One thing that can be done, however, is to make their menus simpler, as has been done on the Canadian Pacific, and to substitute for them where it is possible some other method by which passengers can conveniently and inexpensively get meals en route. In England many fast through trains do not carry dining cars, but passengers can arrange to have lunch baskets put on at convenient station stops and get a good economical meal—cold, it is true, but very palatable. If the pressure becomes so heavy in time on railroad facilities that the weight of passenger trains must be reduced to an absolute minimum, dining cars will have largely to go and coaches will have to be substituted for parlor cars; but reforms such as these might well wait until duplicate competitive passenger service has been eliminated as largely as practicable and the facilities which contribute only to the luxury rather than to the comfort of passengers had been reduced.

REDUCTION OF LOCAL SERVICE

Competitive passenger service generally pays each road engaging in the competition something, or else they would not engage in it. That's the reason why it would be so hard to bring railroad men to an agreement on eliminating duplication. On the other hand, there is a very large amount of local passenger train service which obviously is done at a considerable loss. A passenger train whose earnings average only 60 cents a mile is a very losing proposition. Pressure of public opinion, orders of state commissions, etc., have prevented the reduction of this service. Now, however, the railroads are in a position to show that it is not money but facilities which are being wasted, and on this ground they can justifiably ask railroad commissions and local communities to co-operate with them in bettering conditions. As a matter of fact, the railroads have already begun to reduce local passenger service and substitute therefor mixed train service to quite a large extent. Especially is this true on some of the New England roads and on some of the southern roads. It is easily conceivable, however, that there may be a temptation to carry reductions of local service too far. The public living on local as well as that living on through lines is entitled to as good service as is reasonablly consistent with present conditions, and any drastic reductions in comparatively infrequent local service should be preceded by the elimination of unnecesary duplications in through service.

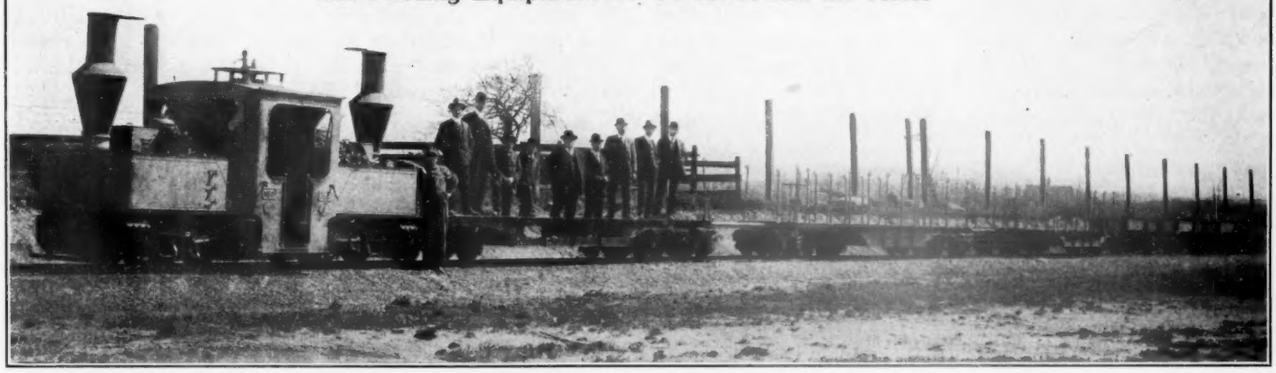


A Few of the Cars America and Canada Have Built for the Other Side

(1) Forty-four Ton Box Car for Russia. (2) Four-wheel 1,200 Pood (43,200 lb.) Capacity Car for Russia. (3) Twenty-Ton Box Car Built for the Paris, Lyons & Mediterranean by the National Steel Car Company. (4) Gondola Car for Russia. (5) Car Built for Italy by the American Car & Foundry Company. (6) Interior View of Gondola Car Built for the French State Railways by the Eastern Car Company. (7) Gondola Built for the Paris-Orleans Railway by the Same Company.

The Railway Supply Industry in the War

Present Work Will Be Continued; Making Munitions and Building Equipment for Ourselves and the Allies



An Assortment of 2 ft. Gage Equipment Built on This Side for Service in France

WHAT is the railway supply industry to do in the war? It will continue to do what it has been doing so efficiently for the past two years, only more so.

The activities in the railway supply field for the past two or three years have been divided into three divisions; the regular domestic business in cars and locomotives; the new business in cars and locomotives for export; and the work on munitions contracts.

Concerning the last—the munitions manufacture—there is not much to be said of direct interest to railway men. It suffices to remark that a very large number of companies have engaged in this work, and as a rule, with a good measure of success. They are continuing to do so, but now the shells or fuses are to be for our own government rather than for England or Russia. A large number of railway supply companies have perfected excellent organizations for this work and with few exceptions they can carry it on with little or no interruption or inconvenience to their regular railway work.

Regular Domestic Business

The railway supply business, like nearly every other kind of business, has had a rather exhilarating experience since the outbreak of hostilities in Europe in August, 1914. For many months, after the beginning of the war, it will be remembered, there was almost no business at all. A builder could hardly give cars or locomotives away even at rock bottom or bargain counter prices. After some months of this, munitions contracts began to be placed, after which there gradually followed, first, foreign contracts for equipment and then domestic orders, until late in 1915 there was an avalanche of orders. Since that time the orders for equipment have continued, but with the additional feature of ever rising prices. Finally and particularly is this true in the case of locomotives. The plants have become so choked with domestic and foreign orders that deliveries of new equipment have become so delayed as to be almost impossible to secure. These are the conditions that continue today, and the end is not yet in sight.

One of the most peculiar things about the domestic purchasing, however, has been the predominance of locomotive buying over freight or passenger car purchasing.

Since the first of the year, for example, the railways of the United States have ordered 1975 locomotives as compared with 1,692 ordered in the same period last year, but they have ordered only 38,987 freight cars as compared with 51,351 freight cars in the first five and one-half months of 1916. The foreign orders, incidentally, are away ahead of last year's for the same period, 1,187 locomotives and 24,550 cars this year comparing with 635 locomotives and 18,325 cars last year. This condition is wholly due to the large French contracts and to the Russian Government's recent large orders, more of which may also be expected in the near future.

Many have tried to figure out why locomotive orders should be running so large while the opposite is true of freight cars. Some have drawn attention, for instance, to the fact that although the railways are suffering the most acute car shortage in their history, they are not buying new cars to make up for it and they are arguing that apparently there is a car congestion rather than a car shortage. This is a matter that is covered in more detail in other articles on this subject, but there are certain features that are of interest to the equipment market.

Take the matter of prices and deliveries. The purchasing of locomotives is in spite of exceedingly high prices and continues in large quantities with deliveries becoming worse almost each week. Some very interesting figures as to locomotive prices were brought out in the recent hearings before the Interstate Commerce Commission. These have been given in the *Railway Age Gazette,* but they will bear repetition. W. B. Biddle, president of the Frisco, said that his road bought locomotives as late as February, 1916, for $36,750, for which later in the year it had to pay $51,000; this year the road inquired for locomotives of the same type and received bids, the lowest of which was $69,750. Howard Elliott declared that locomotives costing $50,350 in January, 1917, cost $57,320 in March, 1917, an increase in price of 13.8 per cent in less than three months. He also presented a comparison of prices showing that a Mikado weighing 400,000 lb. bought in November, 1915, cost 6.65 cents a pound; a Pacific weighing 329,000 lb. bought in February, 1916, cost 8.53 cents a pound, but that a Santa Fe weighing 441,000 lb. bought in March, 1917, cost 13 cents a pound. He added that a 50-ton steel hopper car costing $1,215 in January, 1916, would cost about $2,800 today.

These are the high prices, in spite of which the railways of this country are placing exceedingly heavy orders for locomotives. These orders combined with the heavy orders which have been coming from across the sea have now filled up the locomotive plants to capacity almost until the latter half of next year, so that a road now ordering engines may not expect delivery on them until that time. This in itself may have something to do with the large orders for locomo-

tives from a number of roads which ordinarily would not have come into the market for power until the fall of this year, but which are now taking care to contract for space.

These delayed deliveries for locomotives are proving of considerable importance to the other side of the supply field, the specialty manufacturer, particularly those manufacturing power increasing or fuel economy devices. Many engines are now in service that cannot be retired or replaced by new power, with the result that they are being equipped with superheaters, outside valve gear and such devices which will make them more suited for the work they will be called upon to do.

Freight Cars

There are no doubt several reasons why the orders for freight cars this year should not be as great as those last year, or why, in general, the contracts being placed should not be up to the usual standard for freight car purchases. One reason, and a very elementary one, of course, is that some of the larger roads such as the New York Central and the Pennsylvania, have not bought any cars to speak of since the first of the year.

A more important reason is that a good many railroad officers believe that the so-called car shortage is due rather to the car congestion than to an actual lack of cars. In other words, they look with hopefulness on the campaign being directed at shippers and consignees to load and unload their cars as quickly as possible and the efforts of the Commission on Car Service to secure greater mobility of equipment.

There is no doubt, either, that the railroads are not particularly eager to pay double the normal prices for cars that might be standing idle as soon as the present rush is over. It will be remembered that the roads of this country have reported car surpluses for about nine times as many months in the past ten years as they have reported car shortages. This argument is not given much weight by others because, as they remark, at the present time there seems no likelihood that there will be a falling off in business for many months; and those who take this view almost certaintly are right. Germany, in other words, is by no means defeated and the American railways are going to be called upon to carry troops and supplies to the seaports for many months ahead. Apparently, in other words, whether there be a car shortage, or merely congestion, there are several remedies. Increased or improved motive power, better terminals, greater mobility of cars, and also more cars.

Both sides of this question were brought out in the statement of Samuel Rea, president of the Pennsylvania, before the Interstate Commerce Commission to the effect that "some say that more cars would only add to the congestion," and that, "if the Pennsylvania was instantly given a lot of cars, they would be immediately scattered to the four winds," but further, that "I think if we had more open top cars, they could be put to good use. I think that if we could get deliveries and if prices were reasonable, we should get coal cars, possibly 5,000, but I would not pay the present prices for them."

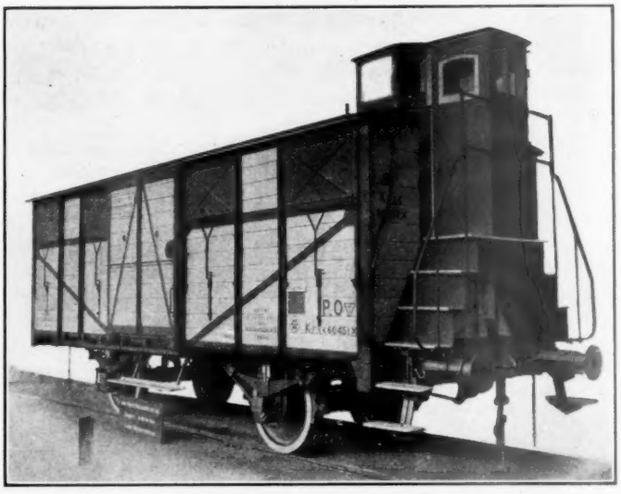
Another argument along the same line is the fact that some roads feel the need for cars so keenly that they will go ahead to build them in their own shops. How great this movement will become is a question; it is no secret, however, that the car builders are not particularly worried about it.

A further element in the freight car situation in general is the ground for belief that the car builders are not looking for new contracts as energetically as they might be if conditions were more favorable. The car builders are very seriously handicapped by a lack of materials and of labor, particularly the former. In fact, some of the plants are so hindered that they are only operating to 50 per cent of capacity. The material situation is complicated because the plates which are largely used in the manufacture of cars are also desired for ships and at the present time the ship builders appear to be given precedence over all other manufacturers. To a certain extent there is also a shortage of wood, because it is needed for ships and for the army cantonments which are soon to be built for America's new armies.

This brings us to the proposition that the United States government should itself purchase 100,000 or 150,000 box and gondola cars which it would lease to the railroads. This matter is treated in an editorial elsewhere in this issue.

There is a good deal to be said about the material situation, and more particularly as to whether it is advisable to tie up the car building plants because of lack of steel which is being diverted to shipbuilding or other industries. This problem is now being worked out. The car builders naturally are making every effort to keep their plants in operation. They understand as well as anybody that there is every reason why the shipbuilding program should be given as careful attention as can possibly be given it. But at the same time they also realize that the railroads must have cars in order to move coal, coke, ore, and other supplies to steel mills so that the latter may work as nearly as possible to capacity.

This incidentally brings us back to the proposition that the government should buy 100,000 freight cars on its own account. Naturally, if the government should place such contracts the builders who are working on them will expect a certain preferential treatment in the matter of material.



Paris-Orleans Railway 20-ton Box Car Built by the Eastern Car Company

It should be noted, nevertheless, that even if the railways did buy these cars themselves, the material situation might, to a certain extent, be cleared up, if sufficient emphasis were placed by the proper authorities on the fact that freight cars are necessary for the industrial welfare of the country, next possibly to the necessity for ship construction.

Apparently the conditions in the material market have not affected the locomotive plants to the same degree that they have struck the car plants. The locomotive plants are suffering more from lack of labor than from lack of material, and their output is being curtailed to some extent. The fact that locomotive plants are not suffering from lack of material is probably due to the fact that the kinds of steel used in locomotive construction are not so much in demand as the plates and angles needed for cars.

The Foreign Orders

The first important foreign order for railway equipment received in this country following the beginning of the war was the Russian order for 250 Decapod locomotives, which was placed in June, 1915, at a time it will be remembered, when a locomotive or car order of any appreciable size was almost as rare as the dodo bird. That order was soon fol-

lowed by others, so that since August, 1914, when the conflict in Europe began, the equipment builders in the United States have received contracts from railways and governments across the seas for 3,757 locomotives and 52,265 cars, while the builders in Canada have received orders for 90 locomotives and 19,800 cars, a total of 3,847 and 72,065, respectively. These orders have been divided by years as follows:

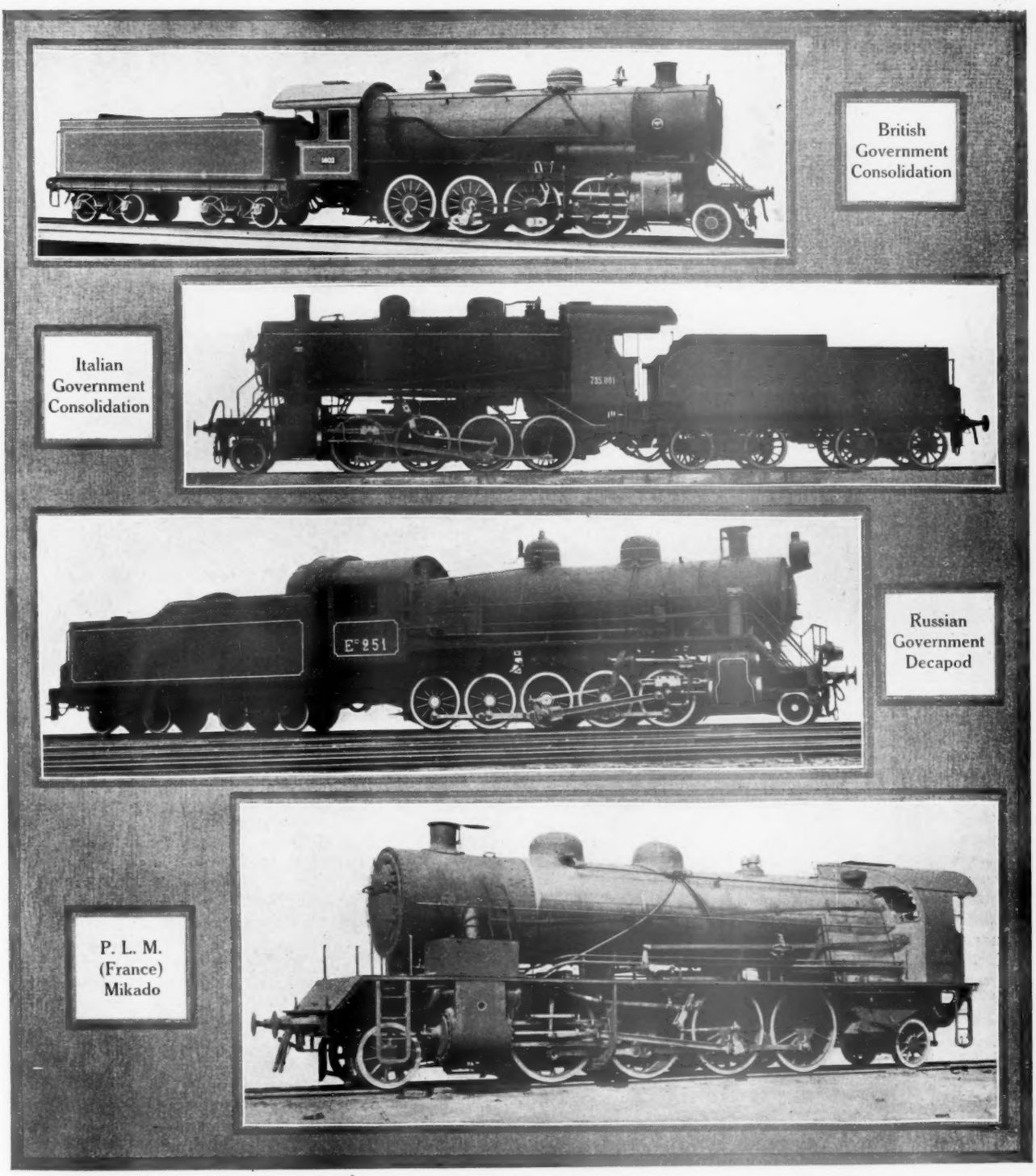
	Locomotives	Cars
1915	604	16,810
1916	2,171	29,255
1917	1,011	26,000

It is interesting to note that the buying has been continually growing in volume up to the present time. Russia has just ordered over 600 locomotives and 10,000 cars. She still has other equipment purchases to make and France also is waiting a chance to order some more cars.

The biggest buyers in the last three or four years have been England, France and Russia, as is shown by the following list:

	Locomotives	Cars
England	880	1,200
France	801	33,100
Russia	1,918	34,765
Italy	100	3,000
Spain	87	...

The equipment that has been built on this side of the



Some of the Big Engines America Has Supplied to the Allies

ocean has been of all sorts and kinds. It has included cars and engines for use directly at the front as well as equipment for use outside the war zone. In other words, the railway supply field has been helping the allies carry on the war and will be among the first of all America's industries to help in the work of reconstruction. Many of the different kinds of cars and locomotives that have been furnished are shown in the illustrations in this article. A number of the lighter locomotives for use within the zone of hostilities are shown elsewhere in articles on "Small Locomotives for Use at the Front," and "War Locomotives Built in America."

It has not been an easy task to build this equipment for foreign roads, and many companies that have tried it have run up against all kinds of snags. One of the most important features has been the way the orders have delayed domestic contracts. It is to the credit of American railwaymen that they realized even before we went in ourselves that America simply had to help the allies in the way of letting them have cars and engines to haul their shells and supplies even at inconvenience to ourselves.

Another thing, perhaps it has been the most important thing, has been the difficulty of working to foreign standards and specifications and of meeting foreign methods of inspection. In Europe, as one American builder has put it, they build cars and locomotives like automobiles. They machine parts, for example, that no American railway would think of machining. Whereas in America pieces of material are usually considered better if they are slightly oversize, in European specifications they have gone to much greater refinements. These same pieces must be exact, principally to save weight. Similarly, the designs for specialties are very different from ours and much more complex.

Nevertheless, American builders have met these European refinements with no small degree of success. But it has not been easy, and several companies have lost no small amount of money in securing the desired results. Contracts in some cases have been held up with resulting penalties and there have been several instances where shops have been completely disarranged because skilled labor could not be secured to do the necessary machine work and the work on the cars had to halt for days at a time. There were few cases, however, where specifications had to be met, that they were not met, somehow.

Under present conditions of manufacture and congestion in American railway equipment manufacturing shops, however, this condition simply could not continue. American builders, in other words, could not be asked to continue to build foreign cars and locomotives under the conditions described and with the speed that was frequently required.

This has led the builders, both of cars and locomotives, to conduct a campaign of education for the foreign purchaser. The Americans, it should be said, have been keen to realize that the foreign cars and engines have been designed to meet the peculiarities of foreign service. They have been able to show, however, that in certain cases American standards of construction have many advantages that might prove of value abroad. To take one example—the journal boxes. The Europeans have been in the habit of using a box, both on engines and cars, fitted with a felt pad and an oil cup or similar contrivance with ducts and tubes which assist in proper lubrication. The Americans have been able to show that in this country we are successfully using the much simpler scheme of oil soaked waste and on considerably heavier equipment. In a number of cases the foreigners have been converted and are now using the American method.

It has, however, been a campaign of education on both sides, and no doubt considerable good will result both to ourselves and our friends overseas. But the American builders to a certain extent have had the upper hand. The United States and Canada have been the only countries where cars and locomotives could be obtained with any degree of despatch or, in fact, almost at all. However they may have felt about it themselves, the builders have had to offer to build equipment to American standards of design and inspection or else they could not touch the contracts. The story is told of one foreign purchaser who came to this country seeking some 20,000-lb. capacity cars built to his country's specifications. He brought with him a bundle about a foot thick of drawings and specifications, among them being one showing a part 7⅞ in. long on which the tolerance allowed was about 1/32 of an inch. Of course, no American builder could bid on a contract of that kind.

The foreigners have been quick to see how conditions stand and in case after case they have come over to American standards. On the double truck Russian box car, for example, there are many American specialties and standards. There are M. C. B. center plates, chilled iron wheels with M. C. B. tread, M. C. B. hand brakes, M. C. B. class C springs, M. C. B. malleable iron journal boxes, Harrison dust guards, Drexel brake beams, Bartley nut locks, waste lubrication with Galena car oil, etc. The material, further, was subject to inspection according to specifications used by the Canadian Pacific. The cars, however, did retain their Russian Westinghouse air brakes and no amount of argument could induce the Russians to get away from the European buffer arrangement.

The Russian four-wheel cars, the 1,200-pood, or 43,200-lb. capacity cars have similarly been built to American standards to a considerable extent. They have chilled iron wheels, M. C. B. journal boxes adapted to a two-axle construction, etc. They will also have Virginia dust guards, American standard brake beams, etc., and in general seem to be quite as much like American equipment as is possible with a four-wheel construction. There have been 10,000 of these cars ordered within the last month.

In the same way, locomotives both for service at the front and for road service have been ordered built to American standards of design almost throughout with the exception of the buffer arrangements and some other details. Russia has ordered no less than 1,271 road engines of this kind from us. England has received or will soon receive a large number of "American" engines which she expects to use in road service in France until the war is over. Various French roads have large numbers of similar engines now on order.

It has been emphasized that the American car and locomotive builders have had little leeway in this matter of building or of not building in so far as possible to American standards. They have been so pressed with work and their system of manufacture has been such that if they could not build to American standards, they could not in the majority of cases, take the contracts.

That leads us to the question whether this may not have a detrimental effect after the war is over and the foreigners once more can get their equipment at home. This cannot be answered at the present time. The leading authorities in the export market differ in their opinions. Some feel that the foreign roads are buying equipment here built to American standards simply because they have no alternative. In other words, the business is war business, and may cease when hostilities come to an end or when reconstruction has got under way. Others take the brighter view that the campaign of education is having a valuable effect, and that the foreign roads are realizing that American methods are good ones, after all. There is one thing certain, however, and that is that it is entirely up to the American builder. If he will realize that the foreigners have adopted standards peculiar to themselves largely because their problem of operation demands these standards, and if he will continue the campaign of education in the future and still hold to his desire to retain this business after the war is over, there should be no fear for the future of our present great export business in cars and locomotives.